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SOUTH AMERICAN NAIADES; A CONTRIBUTION TO THE  
KNOWLEDGE OF THE FRESHWATER MUSSELS  
OF SOUTH AMERICA.

BY DR. A. E. ORTMANN.

(PLATES XXXIV-XLVIII)

INTRODUCTORY.

During the expedition of the Carnegie Museum to central South America, from 1907 to 1909, Mr. J. D. Haseman had as his prime object the collection of Fishes (Haseman, 1911)<sup>1</sup>. At the request of the present writer he, however, took particular pains to collect and preserve freshwater mussels. The result was one of the finest and largest collections of South American *Naiades* ever secured. The value of this collection is enhanced by the fact that a great number of specimens were preserved in alcohol with the soft parts, and the study of their anatomy has thus been made possible. Preliminary notes concerning the most important points of structure have been previously published (Ortmann, 1911a), chiefly in order to set forth the affinities of the South American forms with those of the rest of the world. Only a few typical forms were selected and discussed for this purpose. Further examination of the material has revealed a number of additional and highly interesting facts with regard to the anatomy, which throw light on the taxonomy and phylogeny of this group.

<sup>1</sup> The references in parentheses are to the papers found in the bibliography at the end of this paper.

The present paper is intended to give a full account of these investigations. Naturally all accessible material has been included. In many cases only shells without their soft parts were available. This remark refers largely to older and some more recent material preserved in the Carnegie Museum obtained from various sources. The Haseman Collection likewise contains only the hard parts of many species, but on the other hand, other accessions consisted of shells with soft parts, as, for instance, the specimens of *Anodontites crispatus* from the upper Magdalena-drainage in Colombia, collected by Dr. C. H. Eigenmann, and a collection of a number of species from the La Plata in Argentina, received from Dr. A. Windhausen.

In spite of the comparative wealth of material at hand, in some respects our collections are not complete and do not permit the determination of certain questions, chiefly taxonomic. My greatest difficulty has been to properly identify the "species" at hand. The older writers, Spix, Wagner, Lea, D'Orbigny, Philippi, Hupé, and others, generally described their "species" from very insufficient material, and the author to whom we are most indebted for clearing up the taxonomy of the South American *Naiades*, H. Von Ihering, also was often handicapped by having too scanty material. All previous writers had no clear conception of the range of variation in the various forms, and thus their descriptions generally are those of individuals, often indeed very elaborate and complete, but without proper emphasis laid upon the really important specific characters. Simpson's "Descriptive Catalogue" (1914) did not much improve matters, since he was largely dependent upon the unsatisfactory publications of previous authors.

I do not claim, by any means, that my treatment of these shells overcomes all these difficulties; on the contrary, I am in many particulars not at all satisfied with the results obtained. Nevertheless, I claim that the study of the soft parts of a great many forms has furnished a basis for the proper understanding of what the "species" are, and has, at least, furnished a clue to their systematic arrangement, incomplete and fragmentary, it may be, but which probably will prove to be of great value, when the soft parts of all or most of the species are known.

The difficulty encountered in recognizing the described forms is sometimes exasperating. We should expect, in cases where exact type-localities are given, and where material from these is at hand, that it would not be very great. But, for instance, even of the species described by Von Ihering from São Paulo, I have recognized only a comparatively small number, although I possess a large quantity of material representing the *Naiades* from that state. In other cases, when the type-locality is vaguely, or not at all, given, it has been practically impossible to

be sure of the identification. In consequence I have been compelled to introduce a number of "new species," although I am afraid that some of them are not really "new." But I must leave the task of making out their synonymy to others, who have access to authentic material representing the older forms. It should also be remembered that the introduction of new names is justified by the rules of nomenclature, when an original description is insufficient to enable the species to be recognized.

GENERAL REMARKS AS TO THE AFFINITIES AND GEOGRAPHICAL DISTRIBUTION OF  
THE SOUTH AMERICAN NAIADES.

The earlier writers generally placed the South American forms in the old collective genera, *Unio* and *Anodonta*, to which a kind of intergrading group, called *Monocondylaea*, and certain specialized types, such as *Hyria* and *Castalia*, were added. Von Ihering was the first to recognize that the South American "*Anodonta*," so-called, differs from the *Anodonta* of the northern hemisphere in important characters, and that it is related to certain African forms, *Mutela*, *Spatha*, etc. He calls this genus *Glabaris* Gray = *Anodontites* Bruguière. But he left the other forms under *Unio*. For these Simpson (1900) used the name *Diplodon* Spix. In my preliminary report on South American *Naiades* (Ortmann, 1911a, pp. 108, 120, 129, 130) I was able to show that *Diplodon*, as well as *Hyria* and *Castalia*, differ anatomically from the *Unionidae* of the northern hemisphere, and that Von Ihering's separation of *Glabaris* from *Anodonta* is fully justified and correct. I also found that the genera *Hyria*, *Castalia* (= *Tetraplodon*), and *Diplodon*, recognized by Simpson as a peculiar group, but still placed with the *Unionidae*, are actually more nearly allied to "*Glabaris*," and form with this a group, the family *Mutelidae*, which should be divided into two subfamilies, the *Hyriinae* and *Mutelinae*, each with a number of genera, the anatomy of many of which, however, was still unknown.

Subsequent investigations brought out the fact that Simpson (1900) was correct in associating certain Australian *Naiades* with the South American *Diplodon*, since I was able to show that *D. australis* has practically the same anatomical structure as the South American *Diplodon* (Ortmann, 1912), but that it should be elevated to the rank of a separate genus, *Hyridella* Swainson, admitted as a subgenus by Simpson.

The systematic arrangement and geographical distribution of the families and subfamilies of the *Naiades* would thus be as follows:

## Superfamily NAIADES.

- I. Family MARGARTANIDÆ . . . . . Eurasia and North America (discontinuous).
- II. Family UNIONIDÆ:
  - 1. Subfamily UNIONINÆ . . . . . Eurasia, Africa, North America, southward to Central America.
  - 2. Subfamily ANODONTINÆ . . . . . Eurasia, North America, southward to Central America.
  - 3. Subfamily LAMPILINÆ . . . . . North America southward to Mexico.
- III. Family MUTELIDÆ:
  - 1. Subfamily HYRIINÆ . . . . . South America (but not in Central America), Australia.
  - 2. Subfamily MUTELINÆ . . . . . South America to southern Mexico, Africa.

I can not improve upon this arrangement at present. It possibly might be advisable, in future, to elevate the two South American subfamilies to the rank of families, but I refrain from doing this, chiefly because the African and Australian forms belonging to them are too poorly known. The fact that in South America two groups of *Naiades* are found, which are more closely allied to each other than to any other group, is well expressed by uniting them into *one* family (*Mutelidæ*).

The more primitive subfamily, *Hyriinæ*, is found all over South America, but becomes rare in the northern parts (Venezuela and Colombia), and is missing, so far as known, in Central America. It is quite abundant in Chile, where the *Mutelinæ* are absent, and it is also found in Australia.<sup>2</sup>

The more specialized group, subfamily *Mutelinæ*, is found in South America, east of the Andes. It is missing in Chile, but has been reported from the Pacific drainage in Ecuador. It goes into Central America and reaches southern Mexico. On the other hand it is represented in Africa, probably all over the continent, with the exception of the Mediterranean region.

This geographical distribution of the larger groups is extremely significant, for it serves to support certain theories as to the origin of the South American continent, its former connections, and the origin of its fauna. The presence of the *Hyriinæ* both in South America and Australia indicates the former connection of both continents, probably by way of Antaretica, and the fact that species of *Diplodon*, the most primitive of the South American *Hyriinæ*, are found in Chile, is entirely in keeping with this. The fact that *Unionidæ* with certain Hyrine structures<sup>3</sup> are found chiefly in southeastern Asia, suggests that they probably

<sup>2</sup> It is unknown whether all the Australian *Naiades* belong here. *Unionidæ* related to the *Hyriinæ* in having the septa of the marsupium interrupted, are known to me from southeastern Asia (Siam, China) and northwestern America (Pacific slope), but these forms certainly are *Unionidæ* in all other respects.

<sup>3</sup> Interrupted septa in the marsupium are known in the Asiatic *Unionina*: *Lamellidens* (Ortmann, 1911a, p. 106); in *Hyriopsis* and *Contradens* (Ortmann, Nautilus, XXX, 1916, pp. 85 and 106); and, according to the figures of Haas (System. Conchyl. Cabin., XIX, 1911 and 1912), also in *Rectidens* and *Acuticosta*.



originated on the old connecting land between Asia and Australia (Sino-Australian continent) or in Australia, and that *Diplodon* first reached Chile (in Mesozoic times) coming from Australia, and subsequently invaded the Brazilian mass. The modern forms of the *Hyriinae* (*Castalia*, *Hyria*) chiefly have their center in the basin of the Amazon, a comparatively young part of the continent.

The more advanced type, represented by the subfamily *Mutelineae*, developed probably in Brazil at the end of the Mesozoic, when it had a chance to spread over the old connection across the Atlantic (Archhelenis of Von Ihering), and the immigration of this stock into Central America is of rather late date (late Tertiary). It is not very likely that the *Mutelineae* reached South America coming from Africa, because there is no trace of them found in southern Asia.<sup>4</sup>

#### DIAGNOSTIC CHARACTERS OF THE SOUTH AMERICAN NAIADES.

(See Text-figures 1, 2, 3.)

Family: MUTELIDÆ Ortmann (1911).<sup>5</sup>

1. Diaphragm between branchial and cloacal cavity formed anteriorly by the gills, posteriorly by a solid union of the mantle margins (Figs. 1, 2, 3, t). (No such mantle connection in *Unionidae*).

2. Anterior end of inner gill (Figs. 1, 2, 3, i) broadly attached, and in contact with posterior base of palpi (h). (In the *Unionidae*, there is always a longer or shorter space between these parts.)

3. Anal and branchial openings (a and b) sharply separated from each other by the union of the mantle margins (See Character 1); anal opening open or closed above, but there never is a supra-anal opening. (In the *Unionidae*, the anal may be open, but, when closed, there is always a supra-anal opening.)

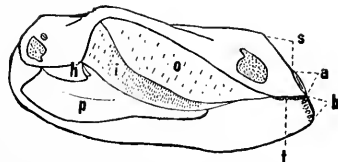


FIG. 1. Diagram of soft parts of female of *Diplodon trifidus* (Lea). Natural size, left section of mantle removed. a, Anal opening; b, Branchial opening; h, Palpi; i, Inner gill; o, Outer gill; p, Pes; s, Closed part of anal opening; t, Union of mantle separating anal and branchial openings.

<sup>4</sup> In Africa there are also *Unionidae* of the subfamily *Unioninæ*; they undoubtedly point to a connection with Asia, since such forms are plentiful there, and this indicates a different route of immigration from that of the *Mutelineae*.

<sup>5</sup> The name depends upon the investigation of the anatomy of the African genus *Mutela*, which is unknown, but we have every reason to assume, chiefly through Von Ihering's study of the shell, that this genus will fall under this family. The family name *Mutelidae* was first used by H. & A. Adams (1858), but for an entirely different association of forms. The *Mutelidae* of Simpson (1900) correspond to our *Mutelineae*.

4. Gills with or without water-tubes, and with isolated, scattered inter-laminar connections, or with interrupted or solid septa. (In the *Unionidae*, mostly uninterrupted septa and water-tubes are found; very rarely are they interrupted; the forms with the latter probably form the connection with the *Mutelidae*.)

5. Marsupium only in the inner gill (Figs. 1, 2, 3, i). (In the *Unionidae*, the marsupium is either in all four gills, or in the outer gills, never in the inner gills alone.)

6. Certain advanced genera of the *Mutelidae* show a tendency to close the branchial opening in front by a mantle connection. (Such a connection is entirely unknown in the *Unionidae*.)

The foregoing are the anatomical characters. The shape of the shell and its parts are subject to so many variations, both in the *Mutelidae* and the *Unionidae*, that it is practically impossible to point out general differentiating characters. Different and often very peculiar types of shell, occurring independently, are frequently observed, so that it is clear that the shells by responding to certain stimuli

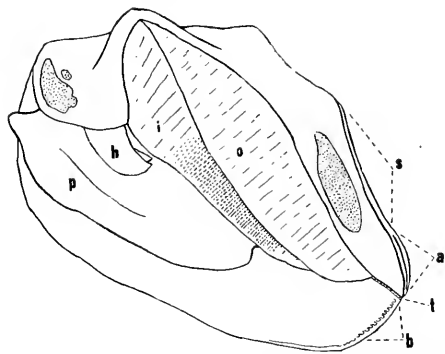


FIG. 2. Diagram of the soft parts of female of *Castalina nehringi* Von Ihering. Natural Size, left section of mantle removed. (Lettering as in Text-figure 1, p. 455.)

and requirements have acquired similar shapes in forms, which belong to different families (convergency or parallelism). Simpson (1900 and 1914) found it impossible to give shell-characters for his subfamily "*Hyrianae*" = *Hyriinae* + certain *Unioninae*, except beak-sculpture, and he was mistaken in this. In our arrangement, this is the only character, which might be mentioned, but not without qualification. We may express it thus: The *Mutelidae* have radial beak-sculpture, if such is present at all;<sup>6</sup> while the *Unionidae* rarely have distinct radial beak-sculpture,

but commonly other types, zig-zag, double-looped, or concentric.

Some *Mutelidae* have, indeed, shells which completely mimic those of certain *Unionidae*. Species of *Diplodon* often externally so much resemble certain species

<sup>6</sup> But even this should be qualified. In certain species of *Anodontites* in the subfamily *Mutelinæ*, I have observed something like concentric beak-sculpture, while, as a rule, the *Mutelinæ* have no beak-sculpture whatever.

of the North American *Elliptio*, that without a minute examination of muscular impressions, hinge-teeth, etc., it is impossible to recognize them, when the locality is unknown. The only reliable character in this case, beak-sculpture, is often obliterated by erosion. Species of *Anodontites* often look like species of *Anodonta*. Here the examination of beak-sculpture, muscular impressions, and the ligamentinal sinus establishes their affinity. On the other hand, there are *Mutelidae* which are easily recognized by the peculiar shape of the shell, and could never be confounded with *Unionidae* (*Castalia*, *Hyria*, *Mycetopoda*, etc.).

The characters of the two subfamilies of the *Mutelidae* are the following:

Subfamily HYRIINÆ Ortmann (1911).

*Hyriana* SWAINSON (1840), very closely corresponds to this. *Lamphoramphus*-group of *Hyriana* SIMPSON (1900).

1. Anal opening (Figs. 1, 2, *a*) closed above (*s*), slit-like (in South American forms), or forming a short, tubular siphon (Australian forms).

2. Marsupium generally an interrupted network of interlaminal connections (Figs. 1, 2, *i*), the connections often standing in rows, thus forming incomplete septa and incomplete, communicating, water-tubes. In rare cases, the interlaminal connections of the marsupium (but not of the non-marsupial gills) form solid septa and isolated water-tubes. Marsupial part of gill often restricted to only a section of it.

3. Non-marsupial gills always with poorly developed, scattered interlaminal connections. (Figs. 1, 2, *o*.)

4. Inner lamina of inner gills always entirely connected with abdominal sac.

5. Palpi (Figs. 1, 2, *h*) subtriangular or subfalciform, with gently curved lower margins, and somewhat produced posterior points.

6. Larva a glochidium (See Fig. 4, p. 469).

As a character of the shell may be mentioned the beak-sculpture, which is generally present (often poorly developed, rarely absent), and always radial. The hinge-teeth are always present, and generally well-developed. Dorsal muscle-scars are present.

Subfamily MUTELINÆ Ortmann (1911).

*Mutelidae* ADAMS (1858), SIMPSON (1900). The name depends, of course, on the genus *Mutela*, the anatomy of the soft parts of which, as has been pointed out already, remains to be investigated.

1. Anal opening (Fig. 3, *a*) open (in South American forms, except *Mycetopoda*) or closed above (in African forms and *Mycetopoda*), slit-like.

2. Marsupium (Fig. 3, *i*) with well-developed, continuous septa, forming well-defined, isolated water-tubes, with a peculiar longitudinal ridge or swelling on the septa near the outer lamina of the gill (Pl. XLVIII, figs. 6, 8). When gravid, only the inner compartment of the water-tubes (towards the inner lamina) is somewhat extended and filled with eggs; the outer compartment becomes a secondary water-tube (Pl. XLVIII, fig. 7*b*).

3. Non-marsupial gills (Fig. 3, *o*) also with septa and water-tubes, but the septa less strongly developed and without a ridge.

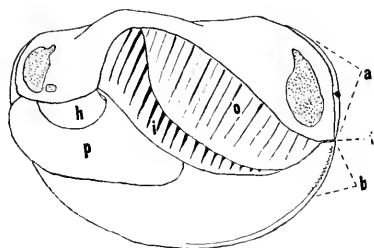


FIG. 3. Diagram of soft parts of female of *Anodontites patagonica rubicunda* (Lea). Natural size, left section of mantle removed. *a*, Anal opening; *b*, Branchial opening; *h*, Palpi; *i*, Inner gill; *o*, Outer gill; *p*, Pes; *t*, Union of mantle separating anal and branchial openings.

4. Inner lamina of inner gills entirely connected with abdominal sac (South American forms), or free from it (African forms).

5. Palpi nearly semicircular, longer than high, with a short posterior truncation, strongly curved lower margins, and indistinct posterior points (Fig. 3, *h*).

6. Larva supposed to be a lasidium (according to Von Ihering).

The shell generally has no beak-sculpture whatever. In very rare cases a trace of concentric sculpture has been observed (see under *Anodontites trapezea*). Hinge-teeth more or less obsolete, reduced in number, or size, and very often entirely absent (Anodontine type of hinge). Dorsal muscle-scars mostly absent in South American forms, very rarely a faint trace seen, or a few are present, as in *Leila*. In African forms, there is one single well-developed dorsal muscle-scar.

#### Subfamily HYRIINÆ Ortmann.

##### GENERAL REMARKS.

Shell of various shapes, subelliptical, subtrapezoidal, subovate, suborbicular, or subtriangular, sometimes more or less alate. Beak-sculpture mostly present, rarely missing, but often indistinct or obliterated by erosion, always of the radial type, with two sets of radial ridges, starting from two points, immediately in front and immediately behind the tip of the umbo, and extending to a varying degree upon the disk. The posterior ridges of the anterior set, and the anterior ridges of the posterior set, generally interfere with each other in the middle of the disk,

coming there into contact in a sharp angle. There are sometimes irregularities in the beak-sculpture obscuring their radial character.

Hinge-teeth always present, but rather variable in number, size, and shape. Normally, there are, as in most other *Naiades*, two laterals in the left valve, and one lateral in the right valve, but individual variations may occur in this respect. The pseudo-cardinals are much more variable. Originally their arrangement seems to be similar to that found in primitive *Unionidae*: that is to say, there are two in the left valve, and one or three in the right; of the latter, the middle one may be the main tooth, fitting in between the two teeth of the left valve, and the anterior and posterior tooth may be accessory. However, this arrangement is very often changed by the suppression of certain teeth, and the addition of others. The most general condition is when of the two pseudocardinals of the left valve the posterior is more or less obsolete, and often entirely wanting, and only the two anterior teeth of the right valve are present. Thus the left valve appears to have only one pseudocardinal (*Aspidon* of Von Ihering) and two laterals, and the right valve has two pseudocardinals (*Dexion* and *Epidexion*), and one lateral. This is chiefly the case in certain species of *Diplodon*, where the pseudocardinals are greatly compressed, and directed more or less parallel to the hinge-line, and this should be kept in mind for the distinction of those species of *Diplodon*, which resemble in shape certain North American species of *Elliptio*, where the normal arrangement shows two pseudocardinals in the left, and one in the right valve.

This is not the only variation. Additional teeth may turn up, and chiefly when in the left valve anterior to (or above) the anterior pseudocardinal an additional tooth is developed (*Epaspidon*, Von Ihering).

The names *Aspidon* and *Epaspidon*, *Dexion* and *Epidexion*, may be used to advantage; but we should not forget that originally there is in the left valve a tooth behind the *Aspidon* (regarded by Von Ihering as being accessory), and that there is often in the right valve another (third) posterior tooth, behind the *Dexion*.<sup>7</sup>

Further, there is much variability in the shape of the teeth. The pseudo-cardinals, as has been stated, are often compressed, lamellar, and smooth. But often they are more solid, or stumpy, when they are frequently more or less split and divided, sometimes almost cut up into a number of teeth. The laterals may be smooth or corrugated, the corrugations standing obliquely on the faces; and in certain genera there are characteristic regular and parallel striations or ridges

<sup>7</sup> Compare also Odhner, 1918, p. 574 ff. (Homologies of hinge-teeth of "*Unionidae*"). Odhner seems to be right in a general way, but the hinge of the *Naiades* is extremely complex and individually variable.

standing vertically to the edge of the teeth. Similar ridges may be present on the pseudocardinals.

In the shape of the muscle-scars on the inside of the shell, there exists no great difference between the *Hyriinae* and *Mutelinæ*. The general rule is in the *Hyriinae* that the upper anterior retractor-scar is distinctly separated from the anterior adductor impression, while the lower anterior retractor-scar is confluent with the latter. Very rarely the lower anterior retractor-scar is isolated. (In the *Mutelinæ* either all three scars are confluent, or the lower anterior retractor-scar is isolated; the upper anterior retractor-scar is hardly ever isolated). The posterior muscle-scars are confluent, the posterior retractor-scar forming a small process at the upper margin of the adductor-scar. The muscle-scars may be deeper or shallower, the upper anterior retractor-scar generally is rounded, small, and remarkably deep.

Dorsal muscle-scars are present in the *Hyriinae* (mostly absent in the *Mutelinæ*); they are variable in number, generally only a few, and are located in the bottom of the shallow beak-cavity, forming an irregular row parallel to the hinge-line, or somewhat oblique. In some forms with deep beak-cavities, these scars are situated on the inner side of the hinge-plate (behind the pseudocardinals and the interdentum).

The line of the mantle-impression is always simple, without a sinus posteriorly. The ligamental sinus lies on the margin of the shell behind the ligament, over the posterior part of the lateral teeth (rarely more in front), and is always small and shallow (longer than deep). (In the *Mutelinæ*, the ligamental sinus is generally much deeper, with a sharp lower point.)

The characters of the soft parts of the *Hyriinae* have been pointed out above.

#### THE GENERA OF THE HYRIINÆ.

The genera of the *Hyriinae* have been hitherto differentiated according to the shape of the shell, the character of the beak-sculpture, and the character and the sculpture of the hinge-teeth. According to Simpson (1914 pp. 1194 ff.) there are seven of them in South America: *Tetraplodon* Spix (*recte Castalia* Lamarek); *Castalina* Von Ihering; *Castaliella* Simpson; *Callonaia* Simpson; *Hyria* Lamarek; *Prisodon* Schumacher; *Diplodon* Spix.

In addition, there are species belonging to this group in Australia (and probably also in New Zealand), which have been placed by Simpson in *Diplodon*, but have been separated by him under the subgenus *Hyridella* Swainson. I have shown (Ortmann, 1912) that the type of *Hyridella* (*Unio australis* Lamarek) actually is closely allied to *Diplodon*, but that probably it is better to regard *Hyridella* as a genus by itself.

The differences of the South American genera may be tabulated as follows:

- a. Shell not alate, or only very slightly alate behind, subelliptical, subovate, subrotund, or subtriangular.
- b. Shell subelliptical, subovate, or subrotund, but not subtriangular. Beaks not much elevated, with radial beak-sculpture, variously developed. Posterior ridge absent or poorly developed; when present and distinct, the shell is elongated. Hinge teeth more or less smooth or dissected, or corrugated, but without vertical parallel ridges. Interdendum very narrow.  
*Diplodon.*
- bb. Shell subtriangular (or subquadrate). Beaks more or less elevated and with rather deep beak-cavities. With or without beak-sculpture. Posterior ridge well developed, defining a distinct posterior slope. Hinge-teeth generally much dissected, and often with parallel vertical ridges. Interdendum well developed, rather broad.
- c. Sides of shell somewhat flattened, posterior ridge moderate, posterior slope elevated in the middle and slightly alate (thus the shell becomes subalate). Hinge-teeth smooth, crenulated, or with parallel ridges.....*Castalina.*
- cc. Sides of shell more or less convex, posterior ridge sharp, posterior slope truncate, not elevated (or only so in the young). Hinge-teeth with parallel ridges.
- d. Radial beak-sculpture present.
  - e. Beak-sculpture strongly developed, extending over a large part of the disk. Surface not concentrically sulcated.....*Castalia.*
  - cc. Beak-sculpture short anteriorly, extending farther on the disk posteriorly. Surface covered with strong, even, concentric ridges (sulcated).....*Castaliella.*
  - dd. Beaks without distinct sculpture, and surface of shell smooth.....*Callonaia.*
- aa. Shell subrhomboidal or subtriangular, strongly alate behind, slightly alate in front.
  - b. Beaks with strong radial sculpture. Posterior ridge moderately developed.....*Hyria.*
  - bb. Beaks without sculpture. Posterior ridge strongly developed, sharp and high.....*Prisodon.*

From the expressions used in distinguishing these genera, it appears that *Diplodon* is a rather composite genus, containing shells of various, more or less indifferent types, while the other genera represent more marked and peculiar shapes, with *Castalina* forming, to a degree, a connection between *Diplodon* and the rest. This indicates that *Diplodon* includes the more primitive and generalized forms of the subfamily, while the others are more specialized and advanced. In a general way, this is supported by the investigation of the anatomy. However, it is much to be regretted that I am unable to give any information as to the structure of the soft parts of the genera *Castaliella* and *Callonaia*. The former is entirely unknown to me, and of the latter I possess only two odd valves. Also of *Prisodon* I only have the soft parts of a young individual. Better material is at hand to represent the other genera.

Generally speaking, the anatomy of all these forms is rather uniform; yet there are certain characters in which they differ, and some of these, indeed, indicate a gradual advance in the structure.

One of these characters has been noticed long ago, and has been discussed in detail by Von Ihering. This is the tendency manifested in certain forms to close the branchial opening in front by a connection of the mantle-margins, which is a character entirely wanting in the *Unionidae*, but it is found occasionally in both subfamilies of the *Mutelidae* (*Hyriinae* and *Mutelinae*). But numerous members of this family do not have this character, and thus it is evident that the absence of this mantle-connection indicates a primitive condition, while its presence is a more advanced stage, expressing the tendency to transform the branchial opening into a closed tube (siphon).

According to Von Ihering (1898), the mantle-connection closing the branchial opening anteriorly is always present in *Castalia*. I have been able to confirm this only partially. Of typical species of *Castalia* I possess the soft parts of six specimens of *C. acuticosta*: they show the branchial opening closed with one exception, where it is open. In *C. undosa*, a somewhat aberrant type, Von Ihering describes the branchial as normally closed, but he says that in four out of twenty-one specimens examined the mantle-connection was missing.<sup>8</sup> Of this species I have five specimens with soft parts, of which three have the branchial closed, while it is open in two of them. In one of the latter, however, a small one, it may be torn. It must be admitted that also in other cases this connection of the mantle may have been torn in life or in preservation.<sup>9</sup> And thus it might be that *normally* this mantle-connection is present in *Castalia*.

*Castalina*, according to Von Ihering, varies in the development of this character in the different species and individuals. He has investigated two males of *C. nchringi*, and one had the branchial closed, the other open. In eight females examined by myself, I found the branchial open. In *C. martensi* Von Ihering found the branchial opening in most cases closed. I have no soft parts of this species. But in two specimens of *C. psammoica*, which I possess, one has this opening distinctly closed in front, in the other this is not the case.

Nowhere else within this subfamily has this character been found. *Castaliella* and *Callonaia* may possess it, but their anatomy is unknown. Of *Hyria* and *Prisodon*

<sup>8</sup> In Von Ihering's description (1893, p. 86) there is a very singular mistake. He speaks of the mantle-connection "Bruecke" between the two "siphons," while he undoubtedly means the connection in front of the branchial "siphon." This is the one which is sometimes missing. The absence of the connection between the anal and branchial openings would be something unheard of; in fact, has never been observed by me in any member of the family.

<sup>9</sup> We must recall that similar variations or mutilations with regard to the mantle-connection which separates anal and supra-anal openings in the *Unionidae* are well established, for instance in the genus *Fusconaia*.



it is positively known that no such mantle-connection exists, and the same is the case in all investigated species of *Diplodon*.

Thus it is seen that *Castalina* and *Castalia* (and possibly also *Castaliella* and *Callonaiia*) form a group within the subfamily, which is not only specialized in the shape of the shell, but also in the tendency to close the branchial opening anteriorly. As *Castalina* forms a transition from *Diplodon* to *Castalia* in the shell, so it is transitional also in this latter character, and thus it is perfectly clear that *Castalina* and *Castalia* cannot be primitive types, and other peculiar characters, which they possess, probably also should not be regarded as primitive.

This is especially true of the parallel ridges vertical to the edge of the lateral hinge-teeth (also sometimes present on the pseudocardinals). This character is best developed in *Castalia* (Plate XXXIX, figs. 8c, 8d), but *Castaliella* is also described as showing traces of it, and *Callonaiia* has it. But here again *Castalina* is transitional toward *Diplodon*. *Castalina nehringi* has, according to Von Ihering, hinge-teeth obliquely corrugated, but never with parallel ridges vertical to the edge. This is quite correct, as far as concerns the laterals; but some of my specimens show that the furrows of the cardinal teeth occasionally may be nearly parallel, thus producing nearly parallel ridges. In *Castalina martensi* vertical ridges are present and well-developed, at least in the anterior section of the lateral teeth, but young specimens do not show them. My specimens of *Castalina psammoica* have the vertical ridges poorly, or not at all, developed.

This sculpture of vertical ridges upon the hinge-teeth in *Castalia* and the allied genera has been much discussed in the literature. It is well known that Neumayr believed that these ridges are homologous to similar structures seen in the *Trigoniidae*, and that *Castalia* should be directly connected with *Trigonia*, and this idea has been taken up by other authors. However, Von Ihering (1893 p. 85) has pointed out that this is incorrect. From the above considerations we now know, that there undoubtedly is a genetic series, which leads from *Diplodon* through *Castalina* to *Castalia*, with the *beginning* at *Diplodon*, and the *end* at *Castalia*; and, consequently, the vertical ridges on the hinge-teeth in *Castalia* are not an ancestral character, inherited from *Trigonia*, but are a new acquisition, marking an independent, comparatively high development of the Naiad-hinge.<sup>10</sup>

*Hyria* and *Prisodon* may, or may not, possess these vertical ridges on the hinge-teeth. If present (*Prisodon alatus*, Pl. XI, figs. 2c, 2d), they are seen chiefly in

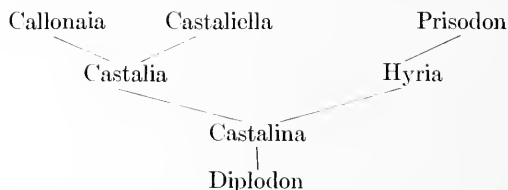
<sup>10</sup> This idea has also been suggested by Pompeckj (Gegen Steinmann's Geologische Grundlagen der Abstammungslehre, im 3ten Jahr.-Ber. Niedersächs. Geol. Ver., 1910, p. 12) in criticizing Steinmann's attempt at a polyphyletic derivation of the *Naiades* from various *Trigoniidae*. Odhner (1918, p. 577, footnote) also considers the sculpture of the teeth in *Castalia* as a secondarily developed character.

old specimens, while they are lacking in the younger ones, but old specimens also may not show them. Thus these two genera should be compared in this respect with *Castalina*, and it is quite possible that they have here their roots, the shape of the shell of *Castalina* also indicating in its elevated posterior slope the "alate" shape of *Hyria*.

Thus we see that the genera *Castalina*, *Castalia*, and probably also *Castaliella* and *Callonaia*, form a series descended from *Diplodon*, characterized by peculiar tendencies in the shell and in the soft parts. The shell tends to assume a more or less triangular shape, with high beaks, with a strong posterior ridge, and a truncated posterior slope. The hinge-teeth tend to develop vertical ridges, and the interdentum becomes wider. The soft parts tend to close the branchial opening in front. All the rest of the soft parts, however, remain here in a comparatively primitive state, being identical with, or standing very close to, the most primitive type of *Diplodon* in the interrupted character of the septa of the gills (See below). It also should be mentioned that the glochidia of these forms, where known, as in *Castalina* and *Castalia*, possess the same shape and the peculiar hooks observed in many species of *Diplodon*, but not in all (See below).

Apparently a side-branch of this series is formed by *Hyria* and *Prisodon*. Here the "alate" character of the shell, slightly indicated in *Castalina*, is emphasized, and developed to an extreme degree; the hinge-teeth have a slight tendency to develop vertical ridges, exactly as in *Castalina*: but in the anatomy these forms do not show the tendency to close the branchial opening in front. Also in the rest of the soft parts they remain upon the primitive *Diplodon*-stage.

We may express the affinities as follows:



The genus *Diplodon* yet remains to be discussed. We have referred to it above as the most primitive type within the subfamily, and there are undoubtedly a number of species contained in it which have a primitive structure. But there are others which differ from them. The first question, however, to be considered is which characters we should regard as primitive.

As far as the shell is concerned, there is considerable variety within this genus.

Most of the species are subelliptical or subovate, and moderately elongated; but others approach more or less the suborbicular shape. For the latter, Simpson has introduced the subgenus *Cyclomya*, and it is true that these form a rather well-defined group, although there are certain species which seem to be intermediate.

The subquadrate or subtrigonal shape of the *Castalia*-group is unknown in *Diplodon*, and the well-defined posterior ridge characteristic of this group is very rarely found; the species, which have it, are always rather elongated (not trigonal), so there cannot be any mistake about them.

The hinge-teeth are also variable, but generally represent, or are easily compared with, the normal type described above (p. 459). There are one or two pseudocardinals and two laterals in the left valve, and two pseudocardinals and one lateral in the right valve. The pseudocardinals may be stumpy, or more or less compressed. They, as well as the laterals, may be smooth, or have corrugations, or may be split and dissected. They never have parallel ridges.

The beak-sculpture also varies a good deal. It is always radial, but the ridges composing it may be shorter or longer, finer or heavier, smooth, or dissected by growth-lines, granular, and sometimes they may be irregular.

But all of these characters of the shell are connected with each other by numerous transitions, and it is impossible to say that any one type is more primitive than another. It is also extremely difficult to arrange the species of *Diplodon* into groups according to these features. Simpson (1914 pp. 1225, 1228) has divided the genus into subgenera and subordinate groups, and has attempted to condense the results in the shape of a "key," but this key is practically worthless, of which fact anyone may convince himself, when he tries to use it for the identification of a species.

However, when I studied the soft parts of the various species at my disposal, I discovered that there are rather well-marked and apparently important *characters shown by the anatomy*, especially by the structure of the *marsupial part of the inner gill of the female*, while the rest of the anatomy is the same in all species.

The interlaminar connections of the gills are extremely weak in the male of *Diplodon*, and in the outer gill of the female (which has the same structure as in the male). They correspond to the description given by me for *Hyria* and *Castalia* (*Tetraplodon*) (Ortmann, 1911a, pp. 115, 117). (See the figures of gills of various species on Plates XLV, XLVI, XLVII; also sections of the gills on Plates XLVII and XLVIII). These interlaminar connections are few and scattered over the face of the gill, and do not form distinct septa (thus resembling the condition seen in the *Margaritanidae*). But in the marsupial part of the inner gill of the female,

these connections become more frequent, are heavier, and stand closer together. Very often we see short connections grouped together either in a reticulate form, or in rows parallel to the gill-filaments, *ie.*, vertical to the edge of the gill (See text-figs. 1 and 2 *i*, on pp. 455-6), and it should be noticed that precisely the same arrangement is also seen in the Australian *Hyridella* (Ortmann, 1912, pp. 100-103, fig. 1). The connections of adjoining vertical rows may alternate in an irregular way, and may thus form irregular transverse or oblique rows. Towards the edge of the gill, and near the base, the connections are often somewhat elongated, stand closer together in the same row, and thus a more distinct arrangement into vertical septa is brought about, separating more distinct water-tubes (ovisacs), which, however, are laterally connected with each other by the interruptions of the septa (See Pl. XLV, figs. 1*b*, 2*b*, 3; Pl. XLVI, figs. 1, 2, 3, 4, 6, 7*a*, 7*b*; Pl. XLVII, fig. 1).

There is no doubt that the arrangement described above is primitive, for it most closely approaches the condition seen in the male gill. The marsupial structure is simply brought about by a more frequent and heavier development of the interlaminae connections of the male, which approach each other, and partly arrange themselves in vertical rows.

A step in advance is observed when the vertical rows prevail over the reticulate arrangement, and extend over the whole marsupial portion of the gill. Such cases are found, and in them the interlaminae connections may be shorter or longer, but they always stand close together in each row, so that we have all through the marsupium the appearance of distinct septa, which, however, are perforated by holes, so that the water-tubes (ovisacs) communicate with each other; this is most evident in *Diplodon piceus* (Pl. XLVI, fig. 2).

Furthermore in a few species (*D. decipiens*, Pl. XLV, fig. 4*b*, and *D. mogymirim*, Pl. fig. 5*c*; see also Pl. XLVII, fig. 7, and Pl. XLVIII, figs. 2*a*, 2*b*), I have observed a further advance in this structure. Here the septa become *solid*, the *interruptions are missing*, and each septum runs from the base of the gill vertically towards the edge, exactly in the manner which we know to be the characteristic condition in the *Unionidae*. Well-defined water-tubes, which do not communicate, are thus formed. The species, which show this structure, have in the marsupial part of the gill hardly any indications of interruptions of the septa. In the non-marsupial portions, as well as in the outer gill of the female, and both gills of the male, the usual structure of *Diplodon* is present, showing few and scattered connections. This reveals that the solid septa of these species of *Diplodon* represent the highest stage in the marsupial development in this genus, and that this feature should not be considered as *homologous* to the septa of the *Unionidae*. It is *analogous*, and has been independently acquired.

There are other differences in the marsupium of the species of *Diplodon*, and these depend upon its location within the gill. In the Australian *Hyridella* nearly the whole inner gill is marsupial, only very small portions at the anterior and posterior ends remaining non-marsupial, a very common condition in the *Unionidae* where the whole outer gill may be marsupial. In *Diplodon* we sometimes observe a similar arrangement (*O. piceus*, Plate XLVI, fig. 2), but generally a more considerable part at the anterior as well as at the posterior end of the gill is non-marsupial, so that the marsupium is restricted to the middle portion (about half) of the gill. The marsupial part may become still more reduced in size, and may be located not in the middle of the gill, but more toward the front, or toward the posterior end. In either case the posterior or anterior half of the gill is nearly or quite non-marsupial. It should be noted that I have observed this shifting of the marsupial part only in cases where the marsupial structure is comparatively primitive, with the interlaminae connections arranged in a reticulate way or as interrupted septa, but never in forms with solid septa, where the marsupial part always extends over a large section in about the middle of the gill. (Compare figures on Pl. XLV, XLVI, XLVII.)

All these differences described in the structure and location of the marsupium are constant within the species. In some forms, indeed, my material is rather scanty; but in quite a number of other cases I have a sufficient number of individuals with soft parts, and I have invariably found that all females of the same form and from the same locality agree with each other, with the only qualification that in young females the marsupium is generally less extended, and occupies a smaller section of the gill (Compare Pl. XLVI, figs. 5*b* and 5*c*; Pl. XLVI, figs. 7*a* and 7*b*).

It should be emphasized that these marsupial differentiations are only found within the genus *Diplodon*. The other genera of which I have anatomical material stand generally upon the stages which I have described as the more primitive in *Diplodon*. Firstly the structure of the marsupium is of the reticulate type in the middle, with more or less development of interrupted septa towards the edges of the gill in *Hyria* (Ortmann, 1911*a*, p. 115) and *Castalia undosa* (*ibid.*, p. 117), while in *Castalina nehringi* the structure showing perforated septa prevails. *Castalia acuticosta* seems to agree with *C. undosa*, but my material consists of only two gravid, rather young specimens, in which the structure cannot be clearly seen on account of the mass of glochidia filling the marsupium. Secondly the location of the marsupium in *Hyria* and *Castalia* is in the middle of the gill (one-fourth at anterior end, less than that at posterior end, non-marsupial). In *Castalina nehringi* (Plate XLVII, fig. 2) the marsupium has moved a little more backward with about

the anterior half of the gill, and less than one-fourth of the posterior end non-marsupial.

Thus it is clear, that, while the *Castalia-Hyria*-group of genera in the shape of the shell and the hinge-teeth, and the *Castalia*-group in the conformation of the branchial openings represent a higher specialisation, in the rest of their anatomy, and chiefly in their marsupial characters, they all remain very close to the primitive *Diplodon*-type.

#### THE GLOCHIDIA.

(See Text-figure 4.)

In conclusion I may say that I have found differences in the glochidia within the genus *Diplodon*. That certain South American species of "*Unio*" have glochidia, was first announced by Lea in the case of *U. peculiaris* and *U. firmus* (Lea, Obs., XII, 1869, Pl. 34, figs. 80, 82; first published in 1868). He describes and figures them as subtriangular in outline, oblique, or upright, the ventral margin with a point, and in the text he says that they are "furnished with hooks." However, he neither describes nor figures these hooks.

Von Ihering (1893, p. 47) states that hooks are missing in all of the South American species examined by him, but that the larvæ are true glochidia.

This is about all we have known hitherto about the larval form of the South American "*Unios*" = *Hyriine*. I have now found that the normal shape (outline) of the glochidia of *Diplodon*, and of the subfamily *Hyriine*, is as described by Lea, namely subtriangular, with a point on the lower margin (see fig. 4). In addition, I have found that some species actually possess a "hook;" but this hook is entirely different from the one so well known in the European genus *Unio* and in the *Anodontina* of Eurasia and North America. The very fact that Lea mentions the hook in a kind of perfunctory way, not calling attention to its peculiar features, suggests that he never saw the real hook, and that he simply took the point of the lower margin of the glochidium for it.

This *Hyriine* hook (Fig. 4, *b*, *c*, *d*, *e*, *f*, *h*, *k*, *l*, *m*) differs entirely from the *Anodontine* hook. The latter is triangular, attached by a broad base to the point of the lower margin, and carries upon its upper surface a number of fine spinules. The *Hyriine* hook is long and narrow, spiniform, with very narrow base, articulated to the point of the lower margin, and without any spinules on the upper face, and furthermore has a peculiar S-shaped curve.

It is perfectly clear that this hook is different from that found in the genus *Unio* and the *Anodontina*. Functionally it may serve the same purpose, that of

forming attachment to fishes, but we have not the slightest direct evidence of this, and Von Ihering directly questions it (*l. c.*, p. 47). Morphologically this organ has been independently developed. It is *analogous* to the *Anodontine* hook, but not *homologous*.

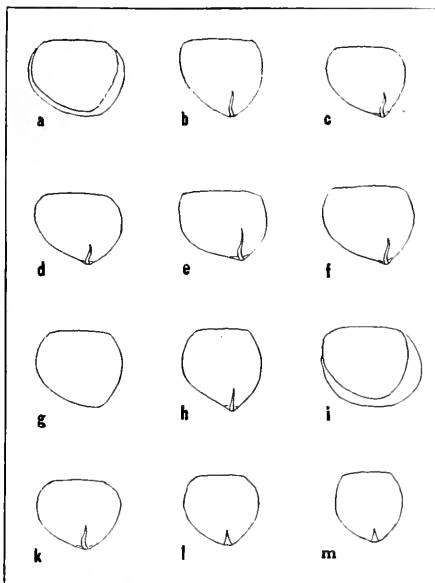


FIG. 4. Glochidia of *Hyriinae*, enlarged fifty times (drawn from photographs).

- a. *Diplodon hasemani* Ortmann (Rio Guaporé), from specimen No. 6. Cat. No. 61.5857.
- b. *D. imitator* Ortmann (Santa Maria), from specimen No. 22. Cat. No. 61.9248.
- c. *D. similinus* Ortmann (Morretes), from specimen No. 2. Cat. No. 61.9250.
- d. *D. vicarius* Ortmann (Aqua Quente), from specimen No. 9. Cat. No. 61.9251 (shell of this specimen figured on Plate XXXVI, fig. 2).
- e. *D. decipiens* Ortmann (Serrinha), from specimen No. 10. Cat. No. 61.9253.
- f. *D. paulista* (Von Ihering) (Mogy Mirim), from specimen No. 10. Cat. No. 61.9256.
- g. *D. charruanus* (D'Orbigny) (Santa Isabel), from specimen No. 5. Cat. No. 61.5861.
- h. *D. piccus* (Lea) (Uruguayana), from specimen No. 1. Cat. No. 61.5862.
- i. *D. hilde* Ortmann (Caehoeira), from specimen No. e. Cat. No. 61.5864.
- k. *D. mogymirim* Ortmann (Mogy Mirim), from specimen No. 48. Cat. No. 61.9260.
- l. *Castalina nehringi* Von Ihering (Salto das Cruzes), from specimen No. 1. Cat. No. 61.5119.
- m. *Castalia acuticosta* Hupé (Rio Guaporé), from specimen No. 1. Cat. No. 61.5112.

I have said that only some *Hyriinae* have this hook. I found it in the case of several species of *Diplodon*, in *Castalina nehringi*, and *Castalia acuticosta*, and it

should be mentioned at this point that these hooks appear only in the fully developed glochidium, while in younger, immature glochidia they are lacking.

But it seems that in certain species of *Diplodon* the hooks are always absent, and in these cases the glochidia fully resemble the figures given by Lea. Of course, in certain cases it is hard to decide whether the glochidia are fully developed, or whether the absence of hooks may be due to the immature condition of the individual. However, I have a case in which I believe I am justified in thinking that the glochidia, when fully developed, have no hooks. In three gravid females of *D. charnuanus*, the glochidia were all alike, and no hooks were observed (Fig. 4g). One of these apparently was discharging, and thus we should expect mature glochidia (unless this were a case of premature discharge).

In a few other cases I am sure that mature glochidia have no hooks, since they are surrounded around the whole lower edge, with a margin, which possibly represents the first beginning of the permanent shell of the adult (Fig. 4a, i). In other groups of *Naiades*, with one exception (*Anodonta imbecillis* Say of North America), nothing of the kind is known in glochidia, as long as they remain within the marsupium, and also in these South American forms, when immature, the glochidia do not possess this margin. I never have seen a trace of hooks here. The margin has much the appearance of that formed in young North American *Unionidae*, after the parasitic stage on fish.

That in these cases the shell should appear at so early a stage, when the larva is still within the marsupium of the mother, is indeed remarkable, and possibly points to the conclusion that the modes and conditions of embryonic development in the *Hyriinae* differ considerably from those of the *Unionidae*.

If the above observations are correct, we would have *three types* of glochidia in the genus *Diplodon*: (1) Of triangular shape, with hooks; (2) Of the same shape, without hooks; (3) Of the same shape, and without hooks, but with a margin around the lower edge, which obliterates the triangular shape.

Whether the second group is real, or only due to incomplete observation, or passes finally into the third, remains to be seen. At any rate, it is very desirable that close attention should be directed to this question in future work on South American *Naiades*.

The size of the glochidia is comparatively large, varying from 0.20 to 0.35 mm., which might be called a good medium size in comparison with the glochidia of the *Unionidae*.

I regret that my observations on the glochidia of the *Hyriinae* are not more satisfactory. There are indications of important differences, but for the present



we must be satisfied with having pointed out this fact, and with hinting that perhaps further knowledge of the glochidia may furnish at least some criteria for a classification of the species of *Diplodon*. The same remark holds good of the marsupial structure. In reference to this we possess a little more knowledge, but it is still too scanty to make an attempt to use it for classification. The genera with the specialized shells of the *Castalia*- and *Hyria*-groups are well defined, but their anatomy and their glochidia do not present any remarkable differentiations, except the structure of the branchial opening in the *Castalia*-group. On the other hand, it appears that the genus *Diplodon* may finally prove to be composed of an aggregation of more varied forms than heretofore supposed, and that the distinctive characters of these are found chiefly in the marsupium and the glochidium.

We may perhaps distinguish within the old genus *Diplodon* a type, which we might regard as having the more primitive features, such as a marsupium composed of interrupted or reticulated septa, occupying the whole or nearly the whole of the inner gill, and probably one of the types of glochidia above described. But it is hard to say, which form this is. I am inclined to regard the hooked glochidium as the more primitive form. The margined glochidium certainly represents a more advanced type. It might finally be possible to split up this genus into smaller genera, one of which should contain these primitive forms, the others to include forms more advanced in regard to their marsupial structure and glochidia. But in the present state of our knowledge this step cannot be taken, and we must be satisfied with an arrangement of the species based upon the characters of the shells.

#### THE SPECIES OF THE HYRIINÆ.

##### Genus *DIPLODON* Spix (1827).

*Diplodon* SPIX, 1827, p. 33 and plate 26.—*DIPLODON* SIMPSON, 1900, p. 872; 1914, p. 1224.<sup>11</sup>

*Type of genus*:—*Diplodon ellipticum* (*cllypticum* err. typogr.) SPIX, 1827, Pl. 26, figs. 1, 2. (Same type given by Simpson, 1900.)

#### THE SUBDIVISIONS OF THE GENUS *DIPLODON*.

Simpson (1914, p. 1225) has made an attempt to divide this genus into subgenera and groups. But he also included in it Australian species under the subgenus *Hyridella* Swainson, which we now regard as a separate genus, and an African

<sup>11</sup> *Diplodon*, as accepted by H. & A. Adams (1858, p. 497) as a subgenus of *Unio*, is an entirely heterogeneous association of species, including forms from all over the world.

form (Subgenus *Laeirostris* Simpson), which we may with considerable confidence assume does not belong here, until the contrary has been positively demonstrated.

Thus restricted, the genus *Diplodon* from our point of view falls in Simpson's arrangement into two subgenera, *Diplodon* (Simpson, 1914, p. 1226) and *Cyclomya* (Simpson, 1914, p. 1278), each subdivided into groups. The characters of the shells of these groups run into each other very insensibly, and are found in various combinations. The subgenus *Cyclomya* is somewhat better defined, inasmuch as the rounded outlines of the species assigned to it contrast rather markedly with most of the elliptical, somewhat elongated shells, assigned by Simpson to typical *Diplodon*. But there are intergrades even here. Typical *Cyclomya* (of the *funerbralis*-type) is irregularly circular, with rounded angles (obscurely pentagonal), and has a short and high shell, with the greatest height situated in the middle of the shell, at about the middle of the ligament. Simpson included in it as species *fontainianus*, and *gratus*, which I regard only as higher and shorter forms belonging to *Diplodon*. They have the greatest height of the shell not in the middle, but more posteriorly, behind the ligament, and thus their outline is distinctly oblique and subtrapezoidal, although approaching the rounded shape.

Simpson, indeed, says in addition, that the beak-sculpture in typical *Diplodon* consists of "unbroken ridges," and that in *Cyclomya* it is "irregularly radial." In both cases this holds good only for certain species, and cannot be used as a generally distinguishing character.

#### Subgenus DIPLODON Simpson.

Simpson, 1900, p. 873; 1914, p. 1226.

Shell more or less elongated; elliptical, ovate, or subtrapezoidal in outline; when short, more or less angular and distinctly oblique, with the greatest height behind the ligament, but not subcircular with the greatest height under the ligament.

The arrangement into groups, as here given, does not rest upon that of Simpson. It is largely made to suit my material, and does not claim to be final. We may express the essential differences in the following key, but with the distinct understanding that there are transitions between the groups, which are hard to place.

#### KEY TO GROUPS IN GENUS DIPLODON.

- a. Shell straight, not oblique, *i.e.*, the longest axis is nearly parallel to the ligament.
  - b. Beak-sculpture covering a considerable part of the disk; ridges, chiefly the posterior, rather heavy.....Group of *D. hylæus*.
  - bb. Beak-sculpture more or less developed, rarely covering a considerable part of the disk; ridges not very heavy and rather uniform.

- c. Beak-sculpture well-developed, fine; ridges cut up into fine nodules... *Group of D. granosus.*
- cc. Beak-sculpture restricted to the region of the beaks; ridges fine, simple, not granular.
  - d. Shell rather compressed and flattened upon the sides, subtrapezoidal in outline, and not distinctly pointed behind..... *Group of D. chilensis.*
  - dd. Shell slightly or not at all compressed, convex upon the sides, mostly subelliptical or subovate in outline, more or less pointed behind.
    - e. Shell rather elongate, not high, subelliptical or subovate... *Group of D. charruanus.*
    - ee. Shell shorter and higher, subovate or subtrapezoidal..... *Group of D. lacteolus.*
- aa. Shell distinctly oblique, with the longest axis forming an angle with the line of the ligament. Outline subovate or subtrapezoidal, sometimes rather high and short..... *Group of D. ellipticus.*

#### 1. GROUP OF *Diplodon hylæus*.

Shell subelliptical, subovate, or subtrapezoidal, more or less pointed posteriorly, straight, not distinctly higher behind, nor oblique. Beak-sculpture well-developed, covering a considerable (but variable) part of the shell; bars rather heavy; those upon, and immediately in front of, the indistinct posterior ridge of the shell are heavier and longer than the rest; one or two of the median bars joining at their lower ends; sometimes the bars are somewhat nodulous (but not granular).

The beak-sculpture is the most essential feature of this group. Additional, but subordinate, characters are found in the hinge-teeth, chiefly the larger ones in each valve, which are triangular, rather thick, ragged, but not compressed. Often there are two pseudocardinals in the left valve.

I have seen the female soft parts of two species, *D. hasemani* and *trifidus*. In both the marsupial part of the inner gill is located in the middle section and has interrupted septa. The former species has the margined type of gloehidium. It seems that this group is not very primitive.

#### 1. DIPLODON HYLÆUS (D'Orbigny).

*Unio hylæa* D'ORBIGNY, 1835, p. 36; 1843, p. 607, Pl. 69, figs. 8, 9.

*Unio hylæus* SOWERBY, XVI, 1868, Pl. 93, figs. 506 *a* and *b* (poor figures).

*Margaron (Unio) hylæus* LEA (*pro parte*), Syn. 1870, p. 31.

*Unio hylæus* VON MARTENS, 1894, p. 164.

*Diplodon hylæus* SIMPSON (*pro parte*), 1900, p. 884; 1914, p. 1274.

*Type-locality*.—"Rio Palometas, Rio Pari, and Rio Tucabaca, in the provinces of Santa Cruz de la Sierra and Chiquitos, in Bolivia."

I have been unable to locate the first two rivers; a *Rio Tucaraca*, in the Chiquitos country (Prov. Santa Cruz de la Sierra in Bolivia), runs to the Paraguay River, and I have no doubt that this river was intended, and it is advisable to take this as the type-locality.

*Other localities.*—Von Ihering (1893, p. 119) gives this species from Rio Paraguay, but also upon D'Orbigny's authority,<sup>12</sup> from the Amazon-drainage. Von Martens (*l. c.*) reports it from Paraguay. No other localities have been hitherto cited.

*New locality.*—Rio Paraguay, São Luiz de Cáceres, Matto Grosso, Brazil, (J. D. Haseman coll., May 25, 1909). One specimen.

*Distribution.*—The new locality is not very far from the type-locality (Rio Tacaraça), about 400 kilometers up the river, and demonstrates that this species belongs to the upper Paraguay drainage in Bolivia and western Brazil. According to Von Martens it goes down this river to Paraguay.

*D. hyleus* and *guaranianus* have been united by Lea, Sowerby, and Simpson, but I think that this is not correct, and that I have both species before me, agreeing well with D'Orbigny's remarks about them. The real *D. hyleus* is a larger shell, with the lower posterior end somewhat more produced, and with differences in the beak-sculpture, which extends over a larger section of the shell, and consists of rounded bars, which are somewhat irregular, and are rugose or slightly nodulous. The figure of D'Orbigny (Fig. 8) shows the sculpture very well.

I have only a single individual of this species, without soft parts, and have drawn the following description from this.

*Description of Shell.*—Shell comparatively small, moderately solid, subovate or subtrapezoidal, slightly higher behind. Height 64 pr. et. of length. Dorsal margin very gently curved, passing into the posterior margin in a blunt, rounded angle. Posterior margin obliquely descending, emarginated, but this emargination undoubtedly is an individual feature, since the growth-lines indicate that it was not present, when the shell was younger. Lower posterior angle slightly produced, but rounded. Lower margin with its lowermost part placed at between two-thirds and three-fourths of the length of the shell (from anterior end), curving up behind. In the anterior portion it slopes upward in an almost straight line, finally curving up into the anterior margin; thus the shell appears slightly narrower in front than behind.

Valves rather flat (in this respect my specimen differs from the original *hyleus*, which is more convex), gently and rather uniformly convex, with the umbonal (posterior) ridge weakly marked, and indicated chiefly by a shallow radial depression upon the posterior slope, which forms the emargination at the posterior margin, and makes the posterior ridge appear slightly biangulate towards the

<sup>12</sup> He says that all forms reported by D'Orbigny from Bolivia are from the Amazon-drainage. In this particular case this is not correct, since the Rio Tucaraça of Bolivia drains into the Paraguay.

posterior end. Diameter of shell 33 pr. et. of length. Beaks not swollen, and not prominent, located at about one-fourth of the length from the anterior end.

Beak-sculpture strongly developed, covering about half of the disk; the longest bars (near the umbonal ridge) are about 20 mm. or more long. There are about sixteen or seventeen radial bars, of which the ninth and tenth, and the eighth and eleventh, unite in sharp angles, and between the ninth and tenth, there is a short odd bar, which is indistinct on account of the erosion of the beaks. Posteriorly the bars increase in length as well as thickness: the anterior bars are comparatively sharp, narrow, but much injured in my specimen; the posterior bars are broader and rounded. Upon the umbonal ridge, the radial bars are again finer, and upon the posterior slope there are four or five additional fine bars, which are shorter, and restricted to the upper part of the slope. On the lower part of the latter, there are a number of fine, irregular, oblique wrinkles. The lower ends of the radial bars are cut up, chiefly near the umbonal slope, into irregular, low tubercles, and traces of such tubercles may be seen near the lower margin of the shell. No distinct lunula is seen in our shell, but this part of the shell is badly eroded.

Epidermis with numerous, irregular, concentric wrinkles, and traces of radial lines. Color brown, much like that of D'Orbigny's figure.

Hinge-line gently curved. Ligamental sinus over the posterior fourth (or a little more) of the lateral teeth, which are gently curved, one in the right, two in the left valve. Pseudocardinals directed obliquely forward and downward, two in right valve, the anterior one narrow, low, and compressed, the posterior one triangular, cut longitudinally into two parts. In the groove behind this tooth, the hinge-line has two small denticles. In the left valve, there are two pseudocardinals, the anterior subtriangular, slightly compressed and simple, fitting into the groove between the two teeth of the right valve, the posterior one broader, and cut into three parts. Leaving out of sight the comparatively stumpy and double character of these teeth, their finer structure can only be regarded as an individual characteristic.

Cavity of shell and beaks shallow. Naere whitish (discolored in the cavity). Anterior adductor-scar distinct, subelliptical; anterior retractor-scar separated from it, small, round and deep; anterior protractor-scar connected with the adductor-scar. Posterior adductor-scar faint, subovate, with an upper triangular process formed by the posterior retractor-scar. Mantle-line faint. Dorsal muscle-scars in the cavity of the beaks.

## MEASUREMENTS.

	Length.	Height.	Diameter	Beaks.
My specimen.....	42 mm.	27 mm. = 64 pr. ct. of L.	14 mm. = 33 pr. ct. of L.	at 10 mm. = 24 pr. ct. of L.
D'Orbigny's figure.....	43 "	25 " = 58 "	16 " = 37 "	8 " = 19 "
Do., in text.....	45 "	60 "	40 "	

*Remarks:* The chief characters of this species, so far as I am able to make them out from the figure and description, and the single specimen at hand, by which it differs from the other species of this group, are found in the general shape (moderately elongated, slightly wider behind, with rounded posterior angle), the beak-sculpture, which covers a rather large portion of the disk, and the rough character of the posterior slope. The greater compression of our shell probably is individual, and also the emargination of the posterior margin.

## 2. DIPODON GUARANIANUS (D'Orbigny).

*Unio guaraniana* D'ORBIGNY, 1835, p. 37; 1843, p. 608, pl. 69, figs. 10-12.

*Type-locality.*—Rio Parana, Itaty, Province of Corrientes, Argentina. No other locality previously known.

*New Localities.*—Paraguay River, Corumbá, Matto Grosso, Brazil (H. H. Smith coll.). One specimen, juv. In swamps of Lambaré, near R. Paraguay, Asunción, Paraguay (J. D. Haseman coll. March 31. 1909). One complete specimen, 6 left valves. Rio Paraguay, São Luis de Cáceres, Matto Grosso, Brazil (J. D. Haseman coll. May 25, 1909). One male, with soft parts, and seven specimens, shells only.

*Distribution.*—Middle Paraná above the junction with the Paraguay River in Argentina and Paraguay, and Paraguay River through Paraguay as far as Matto Grosso, Brazil.

I disagree with previous authors, and regard this species as being distinct from *D. hylæus*. My specimens answer very well to the description and figures of D'Orbigny, and they differ from *hylæus* in their somewhat smaller size, in the more distinctly truncated (more steeply descending) posterior margin, forming a more distinct lower posterior angle, but chiefly in the beak-sculpture, which consists of a smaller number of bars, which are heavier, chiefly posteriorly, and are not so rugose. My specimens are also more swollen than the single individual of *hylæus* at hand, but the latter is, as has been stated, probably exceptional in this.

The beak-sculpture is somewhat variable, chiefly in the length of the bars, which are from 15 to 20 mm. long, and generally cover more than half of the disk, but in the larger shells, sometimes less. There are twelve to fourteen radial bars,

of which the seventh and eighth, or ninth and tenth, unite in the middle of the valve in a sharp angle; sometimes a short odd bar is found between these pairs. The bars are rather fine and sharp in front, but those behind, near the umbonal ridge become broad and rounded, their lower ends being irregular and indistinctly tubercular (much less so than in *D. hylæus*) occasioned by concentric lines cutting across them. These posterior bars also are distinctly longer than the anterior ones. Sometimes there are a few additional fine bars near the beaks on the posterior slope and below them a few oblique wrinkles.

The posterior end of the shell is also somewhat variable, but it never is rounded and slightly biangular, as it is in *D. hylæus*. The posterior margin is obliquely descending, and the lower posterior end is bluntly pointed, the angle being more or less prominent. The lower margin of the shell is evenly convex in some specimens, in others it is more strongly convex a little back of the middle, forming a blunt angle.

The specimen from Corumbá is young, and the beak-sculpture covers all of the shell. It is also a little more compressed than the others, but agrees with them in all other characters.

## MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
Asunción, No. 1.....	21 mm.	14 mm. = 67 pr. ct. of L.	10 mm. = 48 pr. ct. of L.	at 4 mm. = 19 pr. ct. of L.
Do. 2.....	27 "	18 " = 67 "	14 " = 52 "	6.5 " = 24 "
Do. 3.....	28 "	19 " = 68 "	13 " = 46 "	7 " = 25 "
Do. 4.....	33.5 "	22 " = 66 "	13 " = 39 "	8 " = 24 "
S. Luis d. C. (♂).....	39 "	24 " = 62 "	15.5 " = 40 "	8 " = 21 "
D'Orbigny's fig.....	32 "	19 " = 59 "	12 " = 38 "	8 " = 25 "

Thus my specimens are on the average slightly higher and shorter, and somewhat more swollen than the original, unless there are inaccuracies in the figure, which is not impossible, since the figure is 32 mm. long, while the text gives the length as 21 mm.

*Anatomy.*—The only specimen (S. Luis de Cáceres) of which soft parts are at hand, is a male, and has the structure typical of the genus. The anal opening is slit-like, and about three-fourths of the length of the branchial. The branchial opening has fine papillæ. The palpi are triangular and rather small, the posterior margins are not connected. Inner lamina of inner gills connected with abdominal sac. Gill-structure typical.

3. *DIPLODON HASEMANI* Ortmann, sp. nov.

Pl. XXXIV, figs. 1 to 4, shells; Pl. XLVII, fig. 5, section of gills; text-fig. 4a (p. 469), glochidium.

*Locality*.—Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil (John D. Haseman coll., July 20, 1909). Nineteen specimens investigated, all with soft parts; sex of the three smallest not ascertained; the rest were males and gravid females.

*Type-set*: Carn. Mus. No. 61.5857, twelve specimens, among them four males and five gravid females, one with eggs, the others with glochidia.

*Description of Shell*.—Shell small (max. length 28 mm.), solid, swollen, short, subovate, somewhat pointed behind. Diameter 67 to 72 pr. et. of length, as against 59 to 68 pr. et. in *D. guaranianus*. Valves not gaping. Dorsal margin gently convex, passing gradually or with a blunt angle into the anterior margin, which is sometimes almost truncated. The posterior upper margin forms an obtuse, rounded angle with the posterior margin, the latter descending obliquely, gently convex, forming with the lower margin a rather distinct, but blunt posterior termination of the shell, which is little elevated above the base-line. Lower margin gently and uniformly convex, passing in a regular curve into the anterior margin. The anterior portion of the shell does not appear appreciably narrower than the posterior, or very little so.

Valves convex, more so in older specimens, with a rather distinct, but rounded umbonal ridge. Posterior slope subtruncated, a little compressed and elevated in the middle. Greatest diameter of shell 42 to 55 pr. et. of length (32 to 52 pr. et. in *D. guaranianus*). This greatest diameter located more forward toward the beaks than in *D. guaranianus*. Beaks somewhat swollen, but little elevated above the hinge-line, located at 25 to 28 pr. et. of the length. Beak-sculpture of the *hyleus*-type, strongly developed, the posterior bars thicker and longer than the anterior. They cover 10 to 15 mm. of the shell, that is to say, hardly half of it in larger specimens. There are from fourteen to sixteen of them, and the ninth and tenth generally meet at an acute angle, with sometimes a short odd one between this pair. The anterior bars are sharp, the posterior ones broader and rounded, but not so much as in *D. guaranianus*. There are often three or four additional finer bars upon the posterior slope, and some oblique wrinkles behind and below them. The lower ends of the bars are but faintly cut up into tubercles. A lanceolate, rather short, lunula may be present in the larger specimens.

Epidermis with numerous, concentric, irregular striae, finely lamellar in young



specimens, and in older specimens on the posterior slope and toward the lower margin. Fine, obscure, radial lines all over the shell. Color rather uniformly dark brown, but in young specimens there is a distinct indication of a yellowish concentric band, or the region near the beaks may be of this color (suggesting the color-pattern of *D. trifidus*).

Hinge-line gently curved. Ligamental sinus over the middle of the lateral tooth, or a little farther back. Lateral teeth curved, one in right, two in left valve. In one specimen in the right valve there is a distinct, but low, accessory lateral below the normal one. As a rule two pseudocardinals in each valve. They are not much compressed and not much elongated, but rather stumpy, and are very much cut up, especially the posterior ones in each valve. The anterior pseudocardinal in the right valve is more distinctly compressed, but may be very small or even obsolete, and there may be a trace of a third pseudocardinal behind. The posterior pseudocardinal in the left valve is very variable in shape and size.

Cavity of shell and of beaks moderate. Naere in all specimens whitish. Anterior adductor-scar deep, even in young specimens, irregularly rounded. Anterior retractor-scar separated from it, small and deep. Anterior protractor-scar united with the adductor-scar. Posterior adductor-scar less distinct, sub-triangular, with a short upper process formed by the posterior retractor-scar. Pallial line distinct. Dorsal scars few, located in beak-cavity and close to hinge-plate.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figures.
1...	?	12.5 mm.	9 mm. = 72 pr. ct. of L.	5.5 mm. = 44 pr. ct. of L.	at 3.5 mm. = 28 pr. ct. of L.	Pl. XXXIV, fig. 3.
2...	?	15 "	" = 67 "	7 " = 47 "	4 " = 27 "	
2a...	♂	18 "	" = 72 "	7.5 " = 42 "	5 " = 28 "	
4...	♀	23 "	" = 70 "	11 " = 48 "	6.5 " = 28 "	
6...	♀	25.5 "	" = 67 "	12 " = 47 "	7 " = 27 "	
7...	♂	26 "	" = 69 "	14 " = 53 "	7 " = 27 "	Pl. XXXIV, fig. 2.
9...	♀	28 "	" = 70 "	14 " = 50 "	7 " = 25 "	
10...	♂	27.5 "	" = 72 "	15 " = 55 "	7 " = 25 "	Pl. XXXIV, fig. 1.

I cannot discover any sexual differences in the shell.

*Remarks.*—There is no question that this species is very closely allied to *D. guaranianus*, and it may be described as a small, short, rather swollen *D. guaranianus*, with the posterior end of the shell a little sharper, the posterior ridge a little more distinct, and beak-sculpture less developed. Since I possess a good number of specimens of *D. hasemani*, and also a fair number of *D. guaranianus*, I do not doubt the specific distinctness, since the geographical distribution also differs. *D. guaranianus* belongs to the Paraná and Paraguay Rivers, while *D. hasemani* is from the Guaporé, tributary to the Amazon-system. However, a former connection of these systems is indicated by the close affinity of the two species.

*Anatomy.*—I have before me many males and gravid females with soft parts. It should be noted that the smallest gravid females are only 16 mm. long and that this fact indicates that this is a small species, not growing to a larger size, as my material shows, reaching the maximum length of 28 mm.

Anal opening short, slightly shorter than the branchial opening, the latter very short, with few but distinct papillæ. Palpi subtriangular, lower margins convex, posterior margins scarcely connected. Gills normal. Inner lamina of inner gill entirely connected with abdominal sac. In the larger gravid females the middle of the inner gill is marsupial, leaving a little less than one-fourth of the gill both at the anterior and posterior ends non-marsupial. In the smaller females the marsupial part is smaller. The swelling of the charged marsupium is moderate and the gills are charged to near the edge. In the marsupial part the interlaminar connections are arranged in interrupted vertical septa. Since no sterile females are at hand, the exact arrangement could not be seen in a face view, but from sections (Plate XLVII, fig. 5) it is evident that it is very likely more or less reticulate.

*Glochidia* (Text-fig. 4a, p. 469) subtriangular and margined, without hooks. Measurements, without margin: L. 0.30 to 0.31 mm.; H. 0.24 to 0.25 mm.; with margin: L. 0.35 to 0.36 mm., H. 0.29 to 0.30 mm. The presence of eggs and glochidia on July 20 should be recorded with respect to the breeding season.

*Color of Soft Parts in Alcohol.*—Foot blackish in its distal part, this color separated in a sharp line from the light basal part. Rest of soft parts whitish.

#### 4. *DIPLODON TRIFIDUS* (Lea) (1860).

*Diagram of Soft Parts* (See Text-fig. 1, p. 455).

*Unio trifidus* LEA, Obs. X, 1863, Pl. 44, fig. 295.

*Diplodon trifidus* SIMPSON, 1900, p. 884; 1914, p. 1272.

*Type-locality.*—"Buenos Ayres." Never reported again since its original description.

*New Localities.*—Centre of Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil (J. D. Haseman coll., July 20, 1909). Six specimens, all with soft parts. In the three smallest the sex is uncertain (they have the male structure); the others are two males and one (the largest) a gravid female with eggs. Rio Guaporé, São Antonio de Guaporé, Matto Grosso, Brazil (J. D. Haseman coll., July 31, 1909). One male with soft parts.

*Distribution.*—I have doubts as to the correctness of the locality originally given. Von Ihering (1893, p. 118) lists this species with those from the La Plata drainage, but he rests entirely upon Lea. The latter received his single specimen

from D'Orbigny with the above locality; but it is quite possible that a mistake was made, since D'Orbigny also collected in the Amazon system in Bolivia, in the general region, whence our specimens come. Nobody else ever re-discovered this species in the La Plata, although frequent collections have been made. Our material is beyond any doubt this species, and the locality is authentic.

The set, although containing only six specimens, comprises young and old, males and females, and thus it is worth while to give a full description.

*Description of the Shell.*—Of medium size, growing larger than any of the preceding species (maximum length 58 mm.; the type is 42 mm., according to Simpson), rather solid. Outline subelongated, subelliptical, or long-ovate, rounded in front, pointed behind. Height 41 to 54 pr. et. of length. Valves not gaping. Dorsal margin straight in young specimens, very gently curved in older ones. Anteriorly the dorsal margin forms an indistinct angle with the anterior margin in young individuals; in old ones it passes into it gradually. Posteriorly the dorsal margin forms a very obtuse angle with the posterior margin, or, in the largest specimen, passes gradually into it in a gentle curve. Posterior margin obliquely descending, gently curved, meeting the posterior portion of the lower margin in a blunt, but distinct, point, which is elevated above the base-line, but nearer to the latter than to the line of the upper margin. Ventral margin gently and rather regularly convex, its lowest point slightly behind the middle of the shell, ascending in front and behind it. In front it curves up into the anterior margin. Thus the shell has a long-ovate, almost subelliptical outline, with the anterior end only slightly narrowed and rounded, and the posterior more tapering and bluntly pointed.

Valves moderately convex, convexity rather uniform all over the disk, but strongest near the beaks and upon the umbonal ridge, which forms a rounded, but rather distinct, angulation running toward the posterior point. Posterior slope somewhat compressed. Diameter 23 to 36 pr. et. of length. Beaks not swollen, hardly elevated above the hinge-line, located at 18 to 25 pr. et. of the length. Since the shell is more swollen towards the beaks, the latter appear depressed, chiefly in old specimens. Beak-sculpture distinct and well developed, consisting of about sixteen radial bars; the anterior bars are shorter (about 5 mm. long), the posterior much longer, chiefly upon the umbonal ridge, where they are 15 mm. long, or even more. There are two systems of these bars; eight or nine anterior, and seven or eight posterior bars. In the middle of the shell one or two pairs unite at a sharp angle, and sometimes a short, odd bar stands between the innermost pair. The anterior bars are sharp; the posterior ones are also rather sharp near the beaks, but towards their lower ends they gradually become thicker and rounded, broaden-

ing and flattening, and finally disappearing. These broad bars are conspicuous chiefly immediately in front of the umbonal ridge, and are distinctly seen even in our largest specimens, where the beaks are greatly eroded. All these bars are smooth, except for the concentric striæ of the epidermis which cut across them. In some of my young specimens there are a few oblique wrinkles upon the posterior slope, but there are hardly any radial bars, except one, fine, and short, close behind the broad bars of the umbonal ridge. There is a narrow and short lunula in front of the beaks.

Epidermis smooth, but with numerous, irregular, concentric lines, which become sublamellar upon the posterior slope and near the lower margin. There are also numerous fine, irregular, but straight, radiating lines on the disk below the beak-sculpture. The posterior slope has no radial ridges or furrows. Color of epidermis dark to light green, with concentric bands of yellow-brown. The three young specimens are light golden-brown towards the beaks, and light green towards the margins; in the old specimens the green color prevails, and becomes quite dark, but is interrupted by one or two lighter bands of brownish. No traces of color-rays present.

Hinge-line almost straight or very gently curved. Ligamental sinus over the posterior third of the lateral teeth. One lateral in the right, two in the left valve, rather long, distinct, and in old shells gently curving downward behind. Pseudocardinals very variable. Lea describes them as trifid in both valves, but this is not always the case. Of our largest specimen it may be said that the right valve has three teeth: the middle one the largest, directed obliquely downward and forward, triangular, narrow above, broader below, and deeply longitudinally cleft into three ridges; in front of it is an anterior, narrow, compressed tooth, which is connected with the middle one above; behind the largest pseudocardinal is a deep groove, followed by small, ragged elevation of the hinge-plate representing the third tooth. The left valve has one large posterior tooth, which is ragged and fits into the groove behind the middle tooth of the other valve (including the small elevation behind it), and in front of it is a narrow lamellar tooth, fitting into the space between the first and second teeth of the right valve. In the groove between these two teeth of the left valve are two low ridges, corresponding to the clefts of the large tooth of the right valve. In our second largest specimen (No. 1) the same general arrangement is seen, but the anterior tooth of the right valve is very low, while the third (posterior) is more distinct and triangularly elevated. The left valve has two teeth. All these teeth are much less ragged, and the clefts of the middle tooth of the right valve are lacking, and also the corresponding ac-

cessory ridges of the left valve. Similar, but rather variable, conditions are seen in the younger individuals and the specimen from S. Antonio. The rule is that there are three teeth in the right, but only two in the left valve.

Cavity of the shell moderate, that of the beaks shallow. Naere shining, snow-white in my specimens, in two (No. 1 and the one from S. Antonio) with a faint salmon blush in the cavity of the shell. Anterior adductor-scar deeply impressed even in young specimens, irregularly rounded or broadly subelliptical. Anterior retractor-scar located above it, separated from it, deep, small. Anterior protractor-scar connected with it. Posterior adductor-scar distinct, but much less impressed, subovate or subtriangular, with a rounded or triangular appendix above, formed by the posterior retractor-scar. Pallial impression distinct. Dorsal scars five or six, in cavity of beaks, placed irregularly, or in an oblique line.

There are no sexual differences in the shell.

MEASUREMENTS (SPECIMENS FROM SÃO SIMÃO).

No.	Sex.	Length.	Height.	Diameter.	Beaks.
a. ....	?	21.5 mm.	9 mm. = 41 pr. et. of L.	5 mm. = 23 pr. et. of L.	at 4.5 mm. = 21 pr. et. of L.
b. ....	♂	34 "	16 " = 47 "	10 " = 29 "	7 " = 21 "
1. ....	♂	56 "	30 " = 54 "	17 " = 30 "	14 " = 25 "
2. ....	♀	58 "	29 " = 50 "	21 " = 36 "	14 " = 24 "
Lea's figure. ....		42 "	22 " = 52 "	15 " = 36 "	7.5 " = 18 "

In Lea's text there is apparently an error with respect to the height, since the measurement would yield the absurd figure of 89 pr. et. of the length. According to the figure Lea had a specimen with the beaks a little more anterior than any of mine, but otherwise rather closely agreeing with them.

*Remarks.*—This species is related to those of the *hyleus-group*, chiefly to *D. guaranianus*, but it is easily distinguished by its long-ovate shape, with pointed posterior end, and by the beak-sculpture, which, although of the same type, does not extend so far upon the disk. A good character is furnished also by the color of the epidermis and its concentric bands, though we have seen that this pattern is at least indicated in young *D. hasemani*. Lea compares *D. trifuus* with *D. burroughianus* and *parallelopipedon*, but there hardly is any close relationship to the former, and but a superficial resemblance to the latter. I think it belongs to the *hyleus-group*, and may be characterized as an extremely elongated member of that group, in which the beak-sculpture is not quite so fully developed as in the other species.

*Anatomy* (Text-fig. 1, p. 455).—The three smallest of my specimens could not be satisfactorily examined to ascertain the sex, but the gills did not show the mar-

supial structure, so that they may be males. Of the others, three are males, and one is a gravid female with eggs. The fact that this was collected on July 20 gives an indication of the breeding season.

Anal opening (*a* in text-figure) closed above, without forming a supra-anal. Closed part (*s*) two to three times as long as the anal; the latter (*a*) slit-like, short, shorter than the branchial opening. Inner edge of anal practically smooth. Anal separated from the branchial by a solid bridge (*t*) formed by the union of the mantle-margins. Branchial opening (*b*) a little over twice as long as the anal, with distinct papillæ on inner edge; mantle-edges not united in front of it. Palpi (*h*) subtriangular, the lower margins slightly convex, the posterior margins connected at the base.

Gills (*i* and *o*) rather long and moderately wide. The inner (*i*) wider than the outer (*o*) chiefly in front. Outer gill narrowing behind and before, its anterior end near the highest point of the mantle-attachment-line. The inner gill has an almost straight lower margin, and is only little narrower anteriorly; its anterior end is immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac.

Structure of gills normal. In the male both gills have fine, scattered, and interrupted interlaminal connections, running parallel with the gill-filaments, but without forming complete septa or water-tubes. In the gravid female, the eggs are contained in the large middle section of the inner gill (*i*), leaving free less than one-fourth of the gill at the anterior and at the posterior extremity, and also leaving free a narrow zone along the margin. This marsupial part has the interlaminal connections strongly developed, in the shape of interrupted septa, forming incomplete, intercommunicating water-tubes, filled by the eggs in a dense mass, not separated into placentæ. Since no sterile females are at hand, the exact arrangement of the interlaminal connections in a face view could not be made out. The charged marsupium is somewhat swollen and distended, so that the interlaminal connections have stretched out. The outer gill of the female has the structure of the gills of the male.

## 2. GROUP OF *Diplodon granosus*.

Shell subovate or subtrapezoidal, rather elongated, not distinctly pointed behind, straight, not distinctly higher in the posterior part, nor oblique. Beak-sculpture well developed, but fine, and characteristically cut up into numerous fine nodules or granulations, thus obscuring the radial arrangement. The granular sculpture often continued a good distance upon the disk.

The essential character of this group is in the beak-sculpture, which, however, is very variable, although the granular structure is always more or less evident. It is hardly possible to give any additional characters, except that the hinge-teeth are moderately developed, subcompressed, and hardly ever stumpy. Two pseudocardinals are in each valve, but sometimes there are reductions.

I have very little material representing this group. The soft parts of only two specimens are at hand, one too young to be of any value, the other a male. Thus nothing can be said about the structure of the female. All my specimens seem to belong to one species, which is very variable, and has a very limited range in the coastal streams of eastern Brazil.

The genetic connections of this group likewise cannot be properly ascertained. The beak-sculpture does not seem to be very primitive, when compared with the other species of the genus. In the shape of the shell and the hinge, there is similarity to the next group (*chilensis*), which possibly may be the most primitive of the genus.

#### 5. *DIPLODON GRANOSUS* (Bruguière) (1792).

Compare: *Unio multistriatus* LEA, VON IHERING, 1890, p. 165.

*Unio psammactinus* BRONN, VON IHERING, 1893, p. 107.

*Diplodon expansus* VON IHERING, 1910, p. 134.

*Diplodon granosus* (BRUGIÈRE), SIMPSON, 1914, p. 1250.

I am inclined to accept the earlier opinion of Von Ihering (1890), and that of Simpson, that a number of so-called "species," of which Simpson has given a full synonymy, belong here. Possibly several others should be included.

*Type-locality*.—Brazil and Guiana.

*Additional Localities*.—Rio de Janeiro (*psammactinus*, Philippi) (Von Ihering); coastal streams in eastern Brazil, between Rio de Janeiro and Bahia, but not to the south of Rio (Von Ihering); Rio Negro, Prov. Rio de Janeiro, Distr. St. Rita (Dunker's *coriaceus*, Von Ihering); Tayuara, Distr. Santa Gallo, Prov. Rio de Janeiro (Von Ihering); Rio Parahyba do Sul, Rio de Janeiro (Von Ihering); Nova Friburgo, Rio de Janeiro (Von Ihering). Rio Paraguassú, Bahia (Von Ihering, 1910, p. 139, as *multistriatus* Lea). Rio Doce, Espírito Santo (Von Ihering, 1910, p. 134, as *expansus* Kuester).

*New Localities*.—Mountain creek, Raiz da Serra, near Santos, São Paulo, Brazil (J. D. Haseman coll., July 26. 1908). One specimen with soft parts, male. Rio Ribeira, Iporanga, São Paulo, Brazil (J. D. Haseman coll., December 1. 1908). Two specimens, young, one with soft parts of the male type.

In addition, the Carnegie Museum possesses two specimens labeled "*ellipticus*, Brazil," from the Holland Collection, and one specimen labeled "*multistriatus*, Brazil," from the Juny Collection.

*Distribution*.—The new localities represented in the collection made by Hase-man extend the range southward (southwestward) along the coast of Brazil beyond Rio de Janeiro into the southern portion of the state of São Paulo in the small coastal streams. The established range thus reaches from the Rio Paraguassú in the North to the Rio Ribeira in the South.

*Remarks*.—My material is entirely insufficient for the study of the various forms regarded as belonging here. Originally Von Ihering was inclined to unite all these forms with granular beak-sculpture into one species; but later he divided them according to the character of the beak-sculpture, although he admits that there is great variation in this respect. Simpson unites them again, at least in part, but he lets *granuliferus* Dunker stand, and even adds a new species, *D. semigranosus*.<sup>13</sup>

My specimens also vary in the development of the beak-sculpture and in the shape of the shell, but they might very well be forms of one and the same species. The two soft parts at hand are those of males, and the structure of the female is unknown.

The two young specimens from Iporanga show the granular beak-sculpture very well, and I should call them *D. granosus* by all means. Simpson (1914, p. 1249) has described from the same river-system (Rio Ribeira) at Iguapé, São Paulo, Brazil (near the mouth), a *D. mimus*, and Marshall (1917, p. 383, pl. 51, figs. 3-6) has redescribed and figured it. It is founded upon two specimens, larger than mine, and differing somewhat from each other in their proportions, and also from my specimens, but the differences may be individual. The measurements are:

	Length.	Height.		Diameter.	
Simpson.....	37 mm.	28	mm. = 76 pr. et. of L.	17	mm. = 46 pr. et. of L.
Marshall.....	45 "	27	" = 60 "	15	" = 33 "
My specimen.....	29 "	17.5	" = 60 "	8.5	" = 29 "
Do.....	18 "	11.5	" = 64 "	5	" = 28 "

My specimens agree very well with the figures and description, except that there is no lurid-purple in the naere, which is dull (lurid) whitish.

<sup>13</sup> Habitats: "São Paulo River" (location unknown); "Ponte Grande" (location unknown); "Os Perus," São Paulo, Brazil. Marshall (1917, p. 387) redescribes and figures this species, and gives as type-locality: Rio Tieté, São Paulo, and the additional localities "Ponte Grande; São Paulo; Os Perus; and Ponta Grossa, Paraná." The location of Ponte Grande is still unknown. Ponta Grossa is on the headwaters of the Rio Tibagy, tributary to the Paraná Panema.



The beak-sculpture of Simpson's species is unknown, being entirely eroded. It may be that my specimens are this, but I hesitate to unite *D. minus* with *granosus*, before the beak-sculpture of the former has been described.

### 3. GROUP OF *Diplodon chilensis*.

Shell rather compressed, flattened upon the sides, subelliptical, subovate, subtrapezoidal, more or less elongate, not distinctly pointed behind, straight, and not distinctly higher in the posterior part, nor oblique. Beak-sculpture simple, with narrow, straight, uninterrupted radial bars, restricted to the region of the beaks, and not extending far upon the disk. Two of the median bars may be joined at their lower ends.

The generally subtrapezoidal shape of the shell, with flat sides, and the simple character of the beak-sculpture are the chief characters of the group, which may represent the most primitive type within the genus. The posterior end of the shell is mostly not pointed, but more or less rounded, and the posterior ridge is rather indistinct, not prominently angular.

A great number of "species" belong here, which are extremely hard to distinguish. It is in this group that I encountered the greatest difficulties in the identification of the species, and even at present I am not satisfied with the results. This is the more to be regretted, since I have abundant material with soft parts of some of these forms and have found that there are differences in the anatomy, which to all appearance are of specific value.

After many attempts to group these forms, I have finally concluded that the best way, the one that is least liable to lead into error, is to treat these forms *geographically*. It is not very likely that the same identical species occurs in widely separated river-systems.

Forms of this type are found over nearly the whole continent, but apparently they are rare or missing in the region of the great depression which runs from the La Plata up the Paraguay to the Amazon-drainage. I shall begin with the forms from Chile and Patagonia, and proceed then in the direction toward Brazil, going from South to North.

#### 1. SPECIES FROM CHILE AND PATAGONIA.

I have very insufficient material of this group, and cannot express any positive opinion about the species. But it seems that all, or nearly all, of the forms known from Chile belong here. Simpson (1914, p. 1257) admits ten of them: *chilensis* Gray, *solidulus* Philippi, *gassiesi* Kuester, *aplatus* Reeve, *molinae* Philippi, *modestus*

Kuester, *atratus* Sowerby, *obtus* D'Orbigny, *chiloensis* Kuester, *aureus* Simpson. But the differential characters of these are very obscure, and I should not be astonished if some of these names should prove to be synonyms.

Similar forms are known from the eastern foot of the Cordilleras in Patagonia, in the drainage of the Rio Negro. Of these the following material is at hand:

6. *DIPLODON PATAGONICUS* (D'Orbigny) (1835).

*Unio patagonicus* D'ORBIGNY, 1843, p. 610, Pl. 70, figs. 1-4.

*Diplodon patagonicus* SIMPSON, 1900, p. 885; 1914, p. 1275; PILSBRY, 1911, p. 610.<sup>14</sup>

*Type-locality*.—Rio Negro, 10-12 miles above its mouth.

*New Locality*.—Rio Limay, Patagonia (Received in exchange from W. Israël), one right valve.

*Distribution*.—Rio Negro and its tributary Rio Limay in Patagonia.

The specimen at hand is very poor, with the epidermis worn off, but it is undoubtedly this species, which is characterized by its elongated outline and a shallow radial groove upon the posterior slope.

This species is not at all related to *D. parallelopipedon* (Lea), with which it has been associated by Simpson. It has, indeed, a similar elongated outline, but the characteristic strong and elevated posterior ridge of the latter species is entirely absent.

7. *DIPLODON FRENZELI* (Von Ihering) (1893).

*Unio frenzelii* VON IHERING, 1893, p. 111, Pl. 4, fig. 12.

*Diplodon huapensis* BARTSCH, 1906, p. 394, Pl. 27, fig. 1; Pl. 28, fig. 1; Pl. 29, fig. 2.

*Diplodon frenzeli* and *huapensis*, SIMPSON, 1914, pp. 1264, 1265.

*Type-locality*.—Patagonia.

*Other Localities*.—Patagonia, foot of the Cordilleras (Von Ihering); small lake on Victoria Island in Lake Nahuel Huapi, Argentina (Bartsch, *huapensis*).

*Locality Represented in Carnegie Museum*.—Lake Nahuel Huapi, Argentina (C. H. Eigenmann coll., 1919). One gravid female with soft parts.

*Distribution*.—Known from Patagonia, at the foot of the Cordilleras in the region of Lake Nahuel Huapi (Rio Negro drainage). The locality "Chile" given by Von Ihering is rather vague; and "Os Perus, São Paulo, Brazil," given by Simpson for *frenzeli* is probably incorrect.

My material is too poor to give a full account of this species, but I am sure that my only specimen belongs here, and I also believe that *huapensis* is the same.

<sup>14</sup> *Unio patagonicus* Reeve, XVI, 1865, Pl. 21, fig. 93, is not this.

This species has the indifferent and uncharacteristic outline of the forms of the *chilensis*-group: subelliptical or subtrapezoidal, with upper and lower margins subparallel, and rather elongated and compressed shell. It is, however, *remarkable for the anterior location of the beaks* (18 or 19 pr. et. of the length). There is no radial furrow or groove on the posterior slope.

The color of the epidermis of my specimen (the largest known) is dark brown, and the epidermis is wrinkled with concentric lamellæ, but it has been largely eroded. According to Von Ihering, the color is dark brown in the larger specimens, but dark olive in smaller ones, sometimes with lighter green in places. The color of *huapensis* is brown posteriorly, grading to wax-yellow anteriorly.

In all other respects, chiefly in the hinge-teeth, my specimen agrees with the description of *frenzei*; only the posterior end of the shell is a little more broadly rounded, but not very different from the specimen figured by Von Ihering on plate 4, fig. 12i.

*D. huapensis* has been compared by Bartsch with *frenzei*, and he says that it can readily be distinguished from it by the narrower outline, that means to say by the height being less in proportion. This, however, is not correct, as can be seen by comparing the measurements.

The only difference I can see in *huapensis* is the more tapering posterior end. But since this species is founded upon two specimens, of which only one has been figured, this might very well be an individual character.

In the following measurements I leave out Von Ihering's specimens from Chile, which appear to me a little doubtful.

MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
<i>Huapensis</i> (figure) . . . . .	53 mm.	25.5 mm. = 48 pr. et. of L.	14 mm. = 26 pr. et. of L. at 10 mm. = 19 pr. et. of L.	
Do. (type, text) . . . . .	55 "	25.9 " = 47 "	14.5 " = 26 "	
Do. (text) . . . . .	57 "	27.3 " = 48 "	16 " = 28 "	
<i>Frenzei</i> 5b Von Ihering . . . . .	56 "	26 " = 46 "	16 " = 29 "	10 " = 18 "
Do. 5a Von Ihering . . . . .	58 "	28 " = 48 "	17 " = 29 "	11 " = 19 "
Do. Von Ihering . . . . .	68 "	34 " = 50 "	20 " = 29 "	" = 18 "
My specimen (♀) . . . . .	71 "	36.5 " = 51 "	16 " = 23 "	13 " = 18 "

Thus my specimen is more compressed than any of the others; however, a variation of the diameter from 23 to 29 pr. et. is not at all unusual.

*Anatomy.*—The specimen at hand has been preserved with the soft parts, and proved to be a gravid female with glochidia.

Color of soft parts whitish, with black pigment near anal and branchial openings extending forward a good distance along the margin of the mantle, and becoming brown.

Bartsch has given a description of the soft parts of *huapensis*, which refers chiefly to the general features, the color, the structure of the siphons, and the shape of the gills and palpi. But no particulars as to the structure of the gills are given.

Anal opening slit-like, closed above, closed part about four times as long as the open, the latter with the inner edge smooth, and separated from the branchial by a solid mantle-connection. Branchial opening with distinct papillæ. Palpi of moderate size, subtriangular, lower margins curved, posterior margins not connected at base.

Gills nearly of the same width posteriorly, the inner much wider than the outer anteriorly. Outer gill subtriangular, its anterior end at the highest point of the mantle-attachment-line. Inner gill with gently convex margin, very little narrower anteriorly, broadly attached in front, its anterior end immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Interlaminar connections of non-marsupial gills weakly developed, scattered. *Marsupium* located in the inner gill, but not occupying all of it, leaving nearly one-fifth of the gill free anteriorly, and about two-fifths posteriorly, so that the marsupium is distinctly shifted forward, lying in the second and third fifth of the gill (from the anterior end). Interlaminar connections of the marsupium forming interrupted septa, the septiform structure apparently prevailing (this is not quite clear, since the structure is obscured by the masses of glochidia). The charged marsupium is a little swollen, and the glochidia fill it in a loose mass, not being conglutinated.

*Glochidium* subtriangular, strongly oblique, with the point of the lower margin located vertically below the posterior end of the hinge-line. Hooks are present and of the normal S-shape. L. 0.25, H. 0.20; L. of hooks: 0.05 mm. Compared with other species, the glochidium is rather small.

## 2. SPECIES FROM COASTAL STREAMS OF SOUTHERN BRAZIL.

It is a noteworthy fact that species of the *chilensis*-type seem to be absent from the system of the Rio de la Plata (with the exception of the drainage of the upper Paraná). They also seem to be absent in the great Amazons-basin, and northward. But they are found rather plentifully on the Brazilian plateau, beginning at its southern extremity, in the coastal streams in Rio Grande do Sul, going thence northward, and crossing over in São Paulo and Paraná into the drainage of the upper Paraná River.

We shall take up first the species of the coastal streams, and I wish to call

attention (as has been done by Simpson in the case of *D. mimus*) to the great resemblance of these shells, not only among themselves, but also to the North American *Elliptio complanatus* (Dillwyn), distributed over the Atlantic streams of the eastern coast of the United States from Georgia to Maine. This resemblance, of course, is only external and superficial. Closer examination of the hinge, of the adductor-scars, and, if visible, of the beak-sculpture, at once reveals important differences. The anatomy is entirely different.

S. DIPLODON IMITATOR Ortmann, sp. nov.

*Shells*: Pl. XXXIV, figs. 5, 6, 7; Pl. XXXV, figs. 1, 2. *Anatomy of gills*: Pl. XLV, fig. 1. *Section of gills*: Pl. XLVII, fig. 6. *Glochidium*: text-fig. 4b (p. 469).

*Type-locality*.—Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 29, 1909). Twenty-three specimens, all with soft parts, among them males, barren and gravid females, with eggs and with glochidia. Type-set: Carn. Mus. Cat. No. 61.9248. (This is in the drainage of the Rio Guahyba-Jacuihy, far up in the headwaters).

*Additional Locality*.—Rio Jacuihy, Cachoeira, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 26, 1909). One barren and one gravid female, with eggs, both young. (This is farther down, in the middle part of the Rio Jacuihy.)

(Originally there were thirty-four specimens from the type-locality at my disposal, all with soft parts.)

Only once before has a form of this group been reported from the Guahyba-drainage, viz. *D. martensi* Von Ihering, from Taquary and Santa Cruz (probably from tributaries of the lower Jacuihy (See Von Ihering, 1893, p. 102). But these are not typical *martensi*, the original of the latter being "probably from São Paulo)."<sup>15</sup> The dimensions of these specimens from Rio Grande do Sul given by Von Ihering agree fairly well with those of the real *U. martensi*, chiefly the relation of height to length: 49 pr. et. in two specimens from Rio Grande do Sul, 49 pr. et. (text) or 53 pr. et. (figure) in *martensi*. But these dimensions do not agree with my specimens, where the height ranges from 55 to 64 pr. et. and never falls as low as in *martensi*. The diameter of *martensi* is also greater than in my material. For this reason I am compelled to describe my shells as a new species.

*Description of Shell*.—Of medium size (maximum length 80 mm.), moderately solid, rather thin when young, compressed (diameter 26 to 33 pr. et. of length), subelliptical, subovate, or subtrapezoidal, moderately elongated (height 55 to

<sup>15</sup> It is much to be regretted that the type-locality is not better known. It is very doubtful, on account of the great similarity of these forms, whether the real *martensi* can ever be positively identified.

64 pr. et. of length). Valves not gaping. Dorsal margin nearly straight or very gently convex, passing gradually into the anterior margin (rarely forming an indistinct angle). Posterior upper margin forming a blunt angle with the posterior margin or passing gradually into it. Posterior margin obliquely descending, more or less curved, and curving more strongly into the lower margin, without forming a distinct posterior angle. The lower posterior end of the shell is rounded, but hardly biangular. Lower margin in young specimens gently convex, in older ones it is rather straight in the middle. Anterior end of shell not, or very little, narrower than the posterior end. The shell is thus rather straight and not oblique.

Valves only slightly convex, rather flattened upon the sides, with the posterior ridge very indistinct and broadly rounded. Posterior slope somewhat compressed. Greatest diameter near the middle of the shell, but not posterior to it. Beaks not swollen, and not elevated, located at from 20 to 28 pr. et. of the length. Beak-sculpture consisting of about fourteen to sixteen rather sharp and fine, short, radial bars, 5 to 7 mm. long, those upon the posterior ridge hardly longer than the rest, and none of them uniting in the middle of the shell with their lower ends. No distinct granulations present, but sometimes there are a few irregular oblique wrinkles upon the posterior slope near the beaks. A short, narrow lunula in older shells.

Epidermis in young specimens rather smooth and shining, but with fine, irregular, concentric striæ, nowhere lamellar. In old specimens it is less smooth, chiefly on the posterior slope and toward the lower margin with more crowded and rougher striæ. Crinkled radial lines hardly indicated upon the shell. Color in young specimens greenish bronze or brownish, sometimes with indistinct brownish concentric bands, in older shells greenish tints disappear, and the epidermis is dull brown or blackish brown.

Hinge-line gently curved. Ligamental sinus over the middle of the lateral tooth or slightly behind it, in older shells over its last third. Laterals curved, one in right, two in left valve, somewhat rough posteriorly. Pseudocardinals normally two in each valve. In young specimens those of the right valve are obliquely and forwardly descending, compressed, the anterior low and narrow, the posterior higher and a little thicker, crenulated. In older specimens the posterior is thicker and becomes generally more triangular and stumpy. Those of the left valve of young specimens are also compressed, but subtriangular and not very long, crenulated, the anterior one larger than the posterior. In old shells these two teeth are more stumpy, triangular, and not compressed. In rare cases reductions take place, chiefly with regard to the anterior tooth of the right valve, or with regard to the

posterior in the left valve, which may become very small, and sometimes an accessory third posterior tooth may develop in the right valve. Thus the pseudo-cardinals are quite variable in number, shape, size, compression, and development of rugosities.

Cavities of shell and beaks shallow. Nacre blueish white or white, often discolored and with lurid tints (grayish purple) toward the beak-cavities, iridescent posteriorly.

Anterior adductor-scar distinct and impressed, subtriangular. Anterior retractor-scar separated from it, small, round, deeply impressed. Anterior protractor-scar connected with adductor-scar, forming a posterior process of it. Posterior adductor-scar shallow, subtriangular, with an upper process formed by the posterior retractor-scar. Pallial line distinct. Dorsal muscle scars a few, lying in a line in the beak-cavity.

## MEASUREMENTS.

No.	Sex.	Length.	Height		Diameter.		Beaks.		Figure.
11...	♂	40.5 mm.	24	mm. = 59 pr. ct. of L.	12	mm. = 30 pr. ct. of L.	at 11	mm. = 27 pr. ct. of L.	
16...	♂	43 "	27	" = 63 "	11	" = 26 "	11	" = 26 "	
21...	♀	47 "	30	" = 64 "	15	" = 32 "	11	" = 23 "	Pl. XXXV, fig. 2.
29...	♂	62 "	34	" = 55 "	20.5	" = 33 "	14	" = 23 "	Pl. XXXIV, fig. 5.
32...	♀	76 "	44.5	" = 59 "	23.5	" = 31 "	16.5	" = 22 "	Pl. XXXIV, fig. 7.
33...	♀	80 "	44	" = 55 "	26.5	" = 33 "	16	" = 20 "	Pl. XXXV, fig. 1.

*Anatomy.*—Anal opening slit-like, shorter than branchial opening, closed above; closed part about twice as long as open part, no supra-anal formed. Branchial opening separated from anal by a solid connection of the inner mantle-edges. Inner edge of anal almost smooth, that of branchial with distinct papillæ. In front of the branchial the mantle-edges are unconnected. Palpi subtriangular, a little longer than wide, their posterior margins connected at base.

Gills long, the outer subtriangular, wider in the middle than the inner. The inner not triangular, wider than the outer anteriorly, its anterior end attached to the space between anterior end of outer gill and palpi, and in contact with the posterior base of the latter. Inner lamina of inner gill entirely connected with abdominal sac.

Non-marsupial gills (Pl. XLV, fig. 1a) with few, scattered, irregularly disposed interlamina connections. Marsupium (Pl. XLV, fig. 1b) located in the inner gills, occupying only a part of them, at and in front of the middle; at anterior end about one-fifth of the gill remains non-marsupial, and at the posterior end about two-fifths, so that the marsupium occupies two-fifths of the gill, the second and third from the anterior end. This location of the marsupium is constant for

the species (observed in seventeen females), with the only qualification that in young females the marsupium is smaller (less than two-fifths of the gill) but has a similar position.

Marsupial part formed by interrupted septa (Pl. XLV, fig. 1*b*; Pl. XLVII, fig. 6). The arrangement into septa is distinct, but they are frequently interrupted, and their solid portions are short. In the middle of the marsupium they are at the utmost six to eight times as long as thick, and in its other parts they are very short. A distinct quincuncial (reticulate) arrangement is not seen. Toward the margin of the gill the septiform arrangement is again more distinct.

The embryos fill the marsupium in an irregular mass, and the charged marsupium is moderately swollen. Placentæ are not formed.

*Glochidium* (text-fig. 4*b*, p. 469, observed in six specimens) subtriangular, slightly oblique, anterior and posterior margins convex, converging to a point, anterior margin longer than the posterior. Hooks present, of the Hyriine type, with the S-shaped curve. L. 0.27 to 0.28 mm.; H. 0.27 to 0.28 mm.; L. of hook: 0.09 mm.

It should be remarked that in one female the glochidia were immature, and no hooks could be seen; three females had only eggs, and one female was in the act of discharging. The dates of collecting, Jan. 26 and 29, should be recorded as showing the breeding season (midsummer of Southern Hemisphere).

*Remarks on the Specific Characters.*—As will be seen from the descriptions of the following species, *D. simillimus*, *D. vicarius*, and *D. decipiens* are very closely allied to the present species in the shape of the shell; *vicarius* can be readily distinguished by the biangular posterior ridge, and *D. simillimus* is a smaller shell. In other respects it is almost impossible to distinguish these species by the *shell alone*. The few obscure, differentiating characters will be pointed out below under the respective species. However, the investigation of the soft parts has shown that there are interesting differences chiefly in the *location of the marsupium*. In the present species, the marsupium is most fully developed, occupying a rather large part of the inner gills, slightly gravitating toward the anterior end. In the following species (chiefly *simillimus* and *vicarius*) it will be seen that this tendency is increased, and the marsupium becomes smaller, and is being shifted more distinctly forwards (Compare pl. XLV, fig. 1*b*, with Pl. XLV, figs. 2*b*, and 3). It will also be seen that there are slight differences in the glochidia with regard to obliquity and size.



9. *DIPLODON SIMILLIMUS* Ortmann, sp. nov.

*Shells*: Pl. XXXV, figs. 3, 4, 5, 6. *Anatomy of gills*: Pl. XLV, fig. 2.

*Glochidium*: Text-fig. 4c, p. 469.

*Type-locality*.—Rio Nhundiaquara, Morretes, Paraná, Brazil (J. D. Haseman coll., January 3, 1909). *Type-set*: Carn. Mus. Cat., No. 61.9250. Thirty-two specimens with soft parts, males, barren and gravid females with glochidia.

About a dozen additional specimens belonging to the same original lot have been studied. The locality is in a small coastal stream emptying into the Bay of Paranagua.

No shells have ever been reported from the region of Paranagua Bay in Paraná. However, from a little less than one hundred miles to the south, in Santa Catharina, near Barra Itapocu (I believe that the Rio Itapoca, as given by Marshall, stands for this), *Diplodon santamariae* Simpson has been described (Simpson, 1914, p. 1270; and Marshall, 1917, p. 386, Pl. 52, fig. 6; Pl. 55, figs 1-4). This is founded upon three specimens only, and resembles our species to a degree. But judging from description and figures, it is somewhat larger (max. 63 mm.), longer (H. 52-59 pr. et. of L.), and the hinge has the posterior tooth of the left valve missing. Since nothing is known of the anatomy of *D. santamariae*, and the locality is not the same, it would be rash to unite our specimens with this species.

Our species also is much like *U. martensi* Von Ihering, and might fall under this according to Von Ihering's conception. But it cannot be united with it on account of the different dimensions. While in *martensi* the height is said to be from 49 to 57 pr. et., our specimens are mostly less elongated, with the height from 53 to 66 pr. et. of the length. In *D. martensi* the diameter is 32 to 35 pr. et., in the present species from 26 to 37 pr. et. (this agreeing better with *martensi* than with *imitator*). But in the absence of exact localities for *martensi* and any knowledge of its anatomy, and in view of the general resemblance of all of these shells, it is impossible to identify our shell with any previously described, and no other alternative exists, except to describe it as new.

In the characters of the shell *D. simillimus* is very close to *D. imitator*. The description of the latter species would fit it very well, and I shall here only emphasize the distinguishing characters.

1. *D. simillimus* is a smaller shell (max. length 61 mm., as against 80 mm. in *imitator*).

2. The trapezoidal shape, with an angle between the upper and the posterior margins, is seen here only in very young shells. In older shells these two margins form a rather regular curve.

3. The lower margin of the shell of *D. simillimus* is frequently more nearly straight, so that the shell of older specimens appears more humped.

4. Color of epidermis with hardly any green tints, but light to dark bronze-brown, in old shells brown-black.

5. Pseudocardinal teeth never stumpy, chiefly in left valve, but always compressed, although the two of the left valve and the posterior in the right are rather thick in old specimens.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
5...	♂	36.5 mm.	21.5 mm. = 59 pr. ct. of L.	9.5 mm. = 26 pr. ct. of L.	8.5 mm. = 23 pr. ct. of L.	
29...	♂	37.5 "	23 " = 61 "	11 " = 29 "	10 " = 27 "	
18...	♀	42.5 "	22.5 " = 53 "	11 " = 26 "	9.5 " = 22 "	
11...	♂	45 "	27 " = 60 "	13 " = 29 "	9 " = 20 "	Pl. XXXV, fig. 3.
23...	♀	59 "	39 " = 66 "	22 " = 37 "	14 " = 24 "	
22...	♀	61 "	37 " = 61 "	20.5 " = 34 "	15 " = 25 "	Pl. XXXV, fig. 5.

The characters of the shells of this species are rather poorly marked, and can be ascertained only by the examination of extensive material. I have discovered, however, that there are important and constant differences in the anatomy.

*Anatomy.*—Fully agreeing with that of *D. imitator*, but the marsupium is different (See Pl. XLV, fig. 2). It is located in the anterior part of the inner gill, entirely anterior to its middle, and extending forward to within a short distance of the anterior end of the gill, so that anteriorly less than one-tenth of the gill is non-marsupial, while posteriorly fully the posterior half of it is non-marsupial. The interlaminar connections form interrupted septa, but the septiform structure is less distinct than in *D. imitator*, and more of a reticulated (or irregular quincuncial) arrangement is evident. This structure of the marsupium is the same in all females investigated (altogether twenty individuals), and only in young ones is the marsupial part smaller.

The *Glochidium* (Text-fig. 4c, p. 469) differs from that of *D. imitator* in being more distinctly oblique, and being longer than high. L. 0.28 mm., H. 0.24 mm. There are hooks of the same type, which are about 0.10 mm. long.

My specimens were collected on January 3, which date indicates the breeding season, probably its middle, for eight females had only eggs, while nine had glochidia, in part not mature, and with the hooks yet unformed.

The remarkable fact brought out by the study of the anatomy is that, *while the species is extremely hard to distinguish from imitator by the shell, it has at least two anatomical characters (marsupium and glochidium), which are very well marked and constant.*

10. *DIPLODON VICARIUS* Ortmann, sp. nov.

*Shells*: Pl. XXXV, figs. 7, 8; Pl. XXXVI, figs. 1, 2. *Anatomy of gills*: Pl. XLV, fig. 3. *Glochidium*: Text-fig. 4d, p. 469.

*Type-locality*.—In creeks, Aqua Quente (eight miles from Iporanga), São Paulo, Brazil, tributaries of Rio Ribeira (J. D. Haseman coll., November 27, 1908). *Type-set*: Carn. Mus., Cat. No. 61.9251; fifteen specimens all with soft parts, males, barren and gravid females.

*Additional Locality*.—Rio Ribeira, Iporanga, São Paulo, Brazil (J. D. Haseman coll., December 1, 1908). One specimen, male, with soft parts.

Only one species of *Diplodon* has been described from the Rio Ribeira; this is *D. minus* Simpson (1914, p. 1249; Marshall, 1917, p. 383, Pl. 51, fig. 3) from Iguapé, São Paulo, at the mouth of the river. As has been pointed out above (p. 486), this species might possibly be *D. granosus*. But on the other hand a few particulars agree with the present species, as, for instance, the biangulation of the posterior end and the general resemblance to *Elliptio complanatus* mentioned by Simpson. Yet our shells cannot be this, because they are larger, less convex, and have different dimensions. *D. minus* is smaller (max. 45 mm.), and has, according to the measurements given, a considerably higher (60 to 76 pr. et.) and more swollen (D. 33 to 46 pr. et.) shell, while *D. vicarius* has the height only from 52 to 63 pr. et. and the diameter from 26 to 31 pr. et., and is a good deal larger (L. 53 to 68 mm.). Of course, our form may fall under *martensi* Von Ihering, but for the same reasons as in the case of the two preceding species, it cannot be called by this name, and thus we must describe it as new.

It may perhaps be that *D. vicarius*, of which we do not know the beak-sculpture, is the older stage of the young specimens recorded from Iporanga as *D. granosus* (See p. 485). The shape and dimensions agree fairly well, but the size is very different, the maximum length of *granosus* being only 29 mm. and no intermediate specimens between these and minimum length of *vicarius* (53 mm.) are at hand. Thus the question must remain unsettled. *D. granosus* from other localities is also always much smaller than *vicarius*.

This species is also extremely similar to *D. imitator* and *D. simillimus*. In size it stands between them (max. length 68 mm.). The outline is also subtrapezoidal or subelliptical, and the shell is quite compressed, resembling the shape of *Elliptio complanatus* of the United States. The lower margin in the shells before me is always rather straight, but I have not very young specimens. However, from the growth-lines it is seen that young shells must have had a gently curved lower margin. In none of my specimens is the beak-sculpture preserved.

*Characters of the Shell.*—The description of *D. imitator* might also serve for this species. However, the following differences are noticeable:

1. Posterior ridge of shell broad, and more or less distinctly biangulate, producing a biangulation also of the posterior end of the shell. This is the most striking character of the shell. In both *D. imitator* and *simillimus* the posterior end of the shell is evenly rounded without any trace of angulations.

2. Epidermis not so shining as in the two other species, which is due to the development of additional fine concentric wrinkles, which are irregular and best developed upon the posterior slope and near the lower margin. Upon the disk they form indistinct radiating lines (or narrow bands), which are obsolete in the two other species. Color of epidermis of *vicarius* lighter or darker brown, without green tints, and without bronzy lustre.

The hinge-teeth are generally of the type of *D. simillimus*, i.e., they do not become stumpy in old shells. They are, however, very variable, and much cut up, more so than in the two other species, and the posterior pseudocardinal of the left valve frequently is quite small or rudimentary. The nacre is whitish, but often inclines to lurid tints (purplish gray).

#### MEASUREMENTS.

No.	Sex.	Length.		Height.		Diameter.		Beaks.		Figured.		
13...	♂	53	mm. 31	mm. =58	pr. ct. of L.	15.5	mm. =29	pr. ct. of L.	at 12	mm. =23	pr. ct. of L.	Pl. XXXV, fig. 7.
9...	♀	53.5	" 33.5	" =63	"	14	" =26	"	12	" =22	"	Pl. XXXVI, fig. 2.
10...	♀	57	" 34.5	" =61	"	16	" =28	"	11.5	" =20	"	
1...	♀	58.5	" 33.5	" =57	"	15	" =25	"	15	" =26	"	
6...	♂	67	" 35	" =52	"	19	" =28	"	16	" =24	"	
15...	♀	68	" 40	" =59	"	21	" =31	"	15	" =22	"	{ Pl. XXXV, fig. 8. Pl. XXXVI, fig. 1.

No sexual differences in the shell.

*Anatomy.*—I have eight females, six of which are gravid; three with eggs, three with glochidia (immature in one). The structure of the soft parts is exactly as in the preceding species, except that of the marsupium (Plate XLV, fig. 3). As in *D. simillimus*, the marsupium is located in the anterior portion of the inner gill, anterior to the middle, but it occupies a still smaller part, and does not extend so near to the anterior end, and does not reach the middle of the gill. Anteriorly about one-ninth of the gill is non-marsupial, and posteriorly over half of it. The interlaminar connections are arranged in interrupted septa, the septiform arrangement being most evident anteriorly and in the middle of the marsupium, while posteriorly the arrangement is reticulate (indistinctly quineuneial).

The *glochidium* (Text-fig. 4d, p. 469) is similar to that of *D. simillimus*, oblique, but slightly longer. L. 0.30, H. 0.24 mm. There are hooks of the same type, which

are at least 0.09 mm. long. In one specimen with immature glochidia no hooks could be seen.

In this case also the breeding season falls in the winter months of the northern hemisphere, but apparently a little earlier than in the other species (end of November).

Thus this species has anatomical characters of its own, chiefly observable in the size and location of the marsupium. It agrees most closely with *D. simillimus*.

### 3. SPECIES FROM THE DRAINAGE OF THE UPPER PARANÁ.

I have material belonging to the *chilensis*-group from the following tributaries of the Paran : Rio Iguass , Rio Tiet , and Rio Grande in S o Paulo. A form from the Iguass  is noticeably very closely related to the three species from the coastal streams just described. We should bear in mind that the head-waters of the Iguass , from which this form comes, are in close proximity to those of the Rio Nhundiaquara and Rio Ribeira on the eastern watershed.

#### 11. DIPLODON DECIPIENS Ortmann, sp. nov.

*Shells*: Pl. XXXVI, figs. 3, 4, 5, 6. *Anatomy of gills*: Pl. XLV, fig. 4. *Section of gills*: Pl. XLVII, fig. 7. *Glochidium*: Text-fig. 4e, p. 469.

*Type-locality*.—Creek, tributary to the Rio Iguass , Serrinha, Paran , Brazil (J. D. Haseman coll., December 23, 1908). *Type-set*: Carn. Mus. Cat. No. 61.9253, thirteen specimens, males, barren and gravid females, all with soft parts.

No *Naiades* have hitherto been known from the river-system of the Iguass , and, as in the preceding species, none of the names of species which may occur here, can be applied to our specimens with any degree of certainty. Therefore we introduce this form as a new species.

In the *shape of the shell* this species is very close to the three preceding, especially *imitator* and *simillimus*, which it resembles in its subelliptical or subtrapezoidal outline. The latter shape is seen chiefly in younger specimens, while older ones become more subelliptical. The posterior ridge and the posterior end are never biangulate as in *vicarius*. In the glossy epidermis, *D. decipiens* also agrees better with *imitator* and *simillimus*, and the radial lines formed of fine wrinkles are poorly developed. The general description given for *imitator* might be repeated for this species, and the beak-sculpture in particular has the same character. Nevertheless the following peculiarities should be mentioned as diagnostic:

1. The beak-sculpture has a smaller number (ten to twelve) of radial bars, the bars having the same length (5 to 7 mm.)

2. The outline of the shell is more frequently subelliptical, often rather regularly so, with both upper and lower margins almost equally curved. In some specimens, indeed, the lower margin is more nearly straight, but this never causes a distinctly humped shape (so often seen in *simillimus*). No trace of biangulation posteriorly.

3. Epidermis in young shells bronzy-brown or bronzy-green; in older ones it becoming a deep chestnut-color, inclining partly to blackish.

In size this species stands between *imitator* and *vicarius* (maximum length 73 mm.). The relative dimensions are very much like those of the other three species. The hinge-teeth most resemble those of *simillimus*, never being stumpy, as in *imitator*; they are not much cut up; and the posterior pseudocardinal in the left valve has a strong tendency to disappear, being sometimes entirely missing. The nacre is whitish, but generally lurid (purplish gray) in the cavity.

## MEASUREMENTS.

No.	Sex	Length.	Height.	Diameter.	Beaks.	Figured.
a...	♂	26 mm.	14.5 mm. =56 pr. ct. of L.	6 mm. =23 pr. ct. of L. at	6.5 mm. =25 pr. ct. of L.	
c...	♀	35 "	20.5 " =59 "	9.5 " =27 "	7.5 " =21 "	Pl. XXXVI, fig. 6.
3...	♀	58 "	32.5 " =56 "	18.5 " =32 "	15 " =26 "	Pl. XXXVI, fig. 5.
4...	♂	67 "	36.5 " =54 "	20.5 " =31 "	15 " =22 "	Pl. XXXV, fig. 3.
10...	♀	70 "	38 " =54 "	25 " =36 "	16 " =23 "	
6...	♀	73 "	40 " =55 "	25 " =34 "	16 " =22 "	Pl. XXXVI, fig. 4.

No sexual differences in the shell.

*Anatomy*.—Aside from three very young specimens, which probably are a male and two females, I have six males of good size, and one barren female, a gravid female with eggs, and two females with glochidia (in one of them immature).

The anatomy is similar to that of *D. imitator*, *simillimus*, and *vicarius*, but the marsupium (Pl. XLV, fig. 4b) is quite different, essentially differing from that of the other species. It is located in the middle of the inner gill, leaving between one-fifth and one-fourth of the gill at the anterior end, and about one-third of it at the posterior end non-marsupial. Thus the marsupial portion is rather large, and more of it is anterior rather than posterior to the middle. This location comes nearer to what is seen in *D. imitator*, than in the other two species. The most striking character, however, which we have not before encountered, is that the interlaminae connections of the marsupial part are not interrupted, but form *continuous septa*, running from near the base of the gill close to the margin. These septa are heavy and stand very closely, forming regular, isolated water-tubes (See section on Pl. XLVII, fig. 7). The whole of the marsupium has this structure, and no inter-

rupted septa are seen anywhere. That these septa are only a modification of the scattered interlaminae connections is shown by the fact that the latter are found in the non-marsupial gills (See outer gill on Pl. XLV, fig. 4b, and gills of male, Pl. XLV, fig. 4a). All four of my large females show this arrangement, and in the two young ones traces of the beginning of this structure are seen. The embryos fill the water-tubes in loose masses, not forming distinct placentae.

Glochidium (Text-fig. 4c, p. 469) much like that of *D. vicarius*, oblique, L. 0.31, D. 24 mm., with hooks, 0.09 to 0.11 mm. long. One specimen has immature glochidia, but rudimentary hooks can be seen. The date of collecting (December 23) gives a hint as to the breeding season.

While this species is very close to the three preceding in the characters of the shell, it has differences in the soft parts, which are very striking. The structure of the marsupium is extremely interesting, and there is no doubt that it must be regarded at least as of specific value, representing a high specialisation of this organ.

#### 12. DIPLODON PAULISTA (Von Ihering) (1893).

*Anatomy of gills*: Pl. XLVI, fig. 1. *Section of gills*: Pl. XLVIII, fig. 1;

*Glochidium*: Text-fig. 4 f. p. 469.

*Unio paulista* VON IHERING, 1893, p. 93, Pl. 4, fig. 7.

*Diplodon paulista* SIMPSON, 1900, p. 873; 1914, p. 1229.

*Type-locality*.—Piracicaba, São Paulo, Brazil; according to Nehring (1893, p. 166) in Rio Piracicaba Mirim.

*New Localities*.—Rio Tieté, Mogy das Cruzes, São Paulo, Brazil (Headwaters of R. Tieté) (J. D. Haseman coll., July 19, 1908) males, barren and gravid females, originally twenty-five in the lot, all with soft parts. Rio Tieté, Sapina, São Paulo (Exact location unknown, but must be near city of São Paulo) (J. D. Haseman coll., July 23, 1908) one male with soft parts. Creek, tributary to Rio Mogy Guassú, Mogy Mirim, São Paulo, Brazil (tributary to Rio Grande and Paraná) (J. D. Haseman coll., August 7, 1908) males and gravid females, originally seventeen specimens in the lot, all with soft parts.

A detailed description of five specimens has been given by Von Ihering, but the specific characters have remained obscure. The specimens before me agree very well with this description, but it should be noted that the two forms of the shell supposed by Von Ihering to belong to the male and female, do not represent sexual differentiation, but simply individual variations. The more regularly ovate outline, believed to belong to the male, is in fact rather rarely well-developed,

while the other, somewhat more oblique, is more frequent; but both pass insensibly into each other. According to my material younger specimens are more apt to exhibit the more regularly ovate outline.

This species is not very closely allied to those mentioned on the preceding pages, but represents a somewhat different type, and inclines towards the *ellipticus*-group by its often slightly oblique shell. It is much smaller than *imitator*, *vicarius*, and *decipiens*, and also does not attain the size of *simillimus*. The largest specimen before Von Ihering was 57 mm. long, while my largest falls even short of this (45 mm. from Rio Tieté, 51 mm. from Mogy Mirim). The subtrapezoidal shape is only distinct in very young individuals; in larger specimens it becomes subelliptical or subovate, generally a little higher posteriorly and slightly oblique. The ground-color of the epidermis is greenish-olive, and never distinctly brownish, although old specimens may become blackish green. The beak-sculpture consists of fine, sharp; and short radial bars, the number of which is sixteen to eighteen, the median pair having a tendency to unite at the lower ends.

The characters of the inside of the shell have been well described by Von Ihering. The left valve has generally only one pseudocardinal, but sometimes there is a trace of a second posterior one. It should be noted that, as described by Von Ihering, the posterior retractor-scar is separated from, and stands above the posterior adductor-scar, but *not always*, as in some cases it is connected with it, and this may be different, even in the right and left valve of the same individual.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.
Von Ihering . . . . .		48 to 57 mm.	59 to 65 pr. ct. of L.	31 to 35 pr. ct. of L.	22 to 26 pr. ct. of L.
<i>Mogy das Cruzes</i>					
	?	15.5 mm.	8.5 mm. = 55 "	4 mm. = 26 "	at 4 mm. = 26 "
18. . . . .	♀	27 "	16 " = 59 "	8 " = 30 "	6 " = 22 "
10. . . . .	♂	38 "	22 " = 58 "	11.5 " = 30 "	7.5 " = 20 "
23. . . . .	♀	38 "	24 " = 63 "	14 " = 37 "	10 " = 26 "
7. . . . .	♂	41 "	27.5 " = 67 "	14 " = 34 "	10 " = 24 "
14. . . . .	♂	45 "	27 " = 60 "	16 " = 36 "	11 " = 24 "
<i>Mogy Mirim</i>					
9. . . . .	♂	35 "	22 " = 63 "	14.5 " = 41 "	10 " = 29 "
14. . . . .	♂	39 "	23.5 " = 60 "	13 " = 33 "	9.5 " = 24 "
13. . . . .	♂	40.5 "	24 " = 58 "	15 " = 37 "	11.5 " = 28 "
12. . . . .	♂	42 "	28 " = 67 "	18 " = 43 "	11.5 " = 27 "
3. . . . .	♀	48.5 "	29 " = 60 "	16.5 " = 34 "	13 " = 27 "
5. . . . .	♂	51 "	32 " = 63 "	18 " = 35 "	13 " = 26 "

My two sets from the Rio Tieté and from a creek tributary to Rio Mogy Guassú, differ slightly from each other. In the former the size is a little smaller, and the young shells are rather more elongated, thus rendering the average height less. The diameter is also not so great in the shells from the Tieté. The measure-



ments of the dimensions of the two sets largely overlap, and they agree very well with those given by Von Ihering. Of course, my material being more plentiful, the range of the dimensions is wider.

An apparently allied form is *D. suppositus* Simpson (1914, p. 1245; Marshall, 1917, p. 385, Pl. 51, fig. 2; Pl. 54, fig. 1-4).<sup>16</sup> The type is, according to Marshall, from "Paraná, Brazil," and other specimens are from Rio Tieté, São Paulo, and other localities in southern Brazil. This is also a comparatively small form, but, according to the measurements given, it is more elongated, the height being in the type 52 pr. ct. of the length (53 pr. ct. according to Marshall), and in another specimen 58 pr. ct. This differs somewhat from our specimens (58 to 67 pr. ct.) and from Von Ihering's *paulista* (59 to 65 pr. ct.). In addition *suppositus* has a chestnut-bronzy epidermis, while it is greenish in *paulista*. Thus the two forms do not agree.

*Anatomy*.—I have investigated the soft parts of all of my shells, and there were altogether, aside from several small ones, where the sex could not be ascertained, nineteen males, six barren females, five gravid females with eggs, and seven gravid females with glochidia.

The anatomy in general is like that of the genus *Diplodon*. But in this case again the marsupium (Pl. XLVI, fig. 1) in its size and location shows specific peculiarities, exhibited by *all* of my females. It agrees with the preceding species in the fact that it occupies only a part of the inner gill, and in the slightly *anterior* location. But the marsupial part is *very small*, occupying about one-fifth or one-fourth of the length of the gill, leaving a considerable portion non-marsupial at the anterior end, and half or nearly half at the posterior end. The figure on Pl. XLVI, fig. 1, represents a specimen with a rather small marsupium; generally it is a little larger. Thus the marsupium is in the middle of the gill, and slightly in advance of the middle. When charged, it forms here a rounded or oval swelling, rather distant from the base, and extending not quite to the edge. There is a slight variation in the specimens from the two main localities. In those from Mogy das Cruzes it is distinctly in front of the middle; in those from Mogy Mirim more median, but this difference is very slight and not always distinct. The inter-laminar connections form interrupted septa (also seen in the section, Pl. XLVIII, fig. 1), and there is no distinctly reticulate arrangement.

*Glochidium* (Text-fig. 4f, p. 469) rather large, subtriangular, oblique, with hooks. L. 0.32, H. 0.27 mm.; hooks about 0.10 mm. long. (Thus the glochidium is slightly larger than in any of the preceding species.)

<sup>16</sup> The name *suppositus* was first given by Von Ihering (1893, p. 102) without description, from Rio Grande (Upper Paraná, boundary between São Paulo and Minas Geraes).

4. GROUP OF *Diplodon charruanus*.

Shell not compressed, but rather evenly convex and often considerably swollen when old. Outline subelliptical or somewhat subtrapezoidal, elongate, more or less pointed behind, straight, and not oblique. Beak-sculpture simple, with narrow, straight, uninterrupted bars, restricted to the region of the beaks. A few of these bars may be joined at their lower ends.

The chief character by which this group is distinguished from that of *chilensis* is the absence of a flattening of the valves upon the sides. The valves are generally evenly convex, and in consequence of this, at least in larger specimens, the shell appears as more swollen. In other respects, the shell is similar in outline and other characters, except that the posterior end is often produced into a distinct blunt point, which may be more or less elevated above the base-line. There is no distinct tendency of the posterior portion of the shell to be higher than the anterior, and thus the shell is not oblique. A posterior ridge may be distinct or indistinct.

The first species, *D. parallelopipedon*, (Lea) forms a transition toward the group of *chilensis*.

The metropolis of these forms is in the system of the Rio de la Plata, but they are also found in the coastal streams of southern Brazil (Rio Grande do Sul).

## 13. DIPLODON PARALLELOPIPEDON (Lea) (1834).

*Unio parallelopipedon* D'ORBIGNY, 1843, p. 609; CORSI, 1900, p. 447, fig. 30.

*Diplodon parallelopipedon* SIMPSON, 1914, p. 1275.

*Unio parallelopipedon* VON MARTENS, 1894, p. 164; PILSBRY & RUSH, 1896, p. 30.

*Diplodon acutirostris* (LEA) SIMPSON, 1914, p. 1276.

*Diplodon parallelopipedon* and *acutirostris* HAAS, 1913, pp. 22, 23, 52, 53.

*Type-locality*.—Rio Paraná, Province of Corrientes, Argentina.

*Other Localities*.—Arroyo del Rosario, Uruguay (to La Plata) (D'Orbigny); Arroyo de las Vacas, Uruguay (Corsi); Rio de la Plata, Colonia, Uruguay (Pilsbry & Rush); Rio Uruguay, Salto Oriental, Uruguay (Haas); Swamps of Rio Paraná from Buenos Aires to above Corrientes, Argentina (D'Orbigny); Rio Paraguay (Von Ihering, 1893, p. 119); Paraguay (Von Martens); Rio de San Miguel, Prov. of Chiquitos, Bolivia, (D'Orbigny).

The last locality deserves special attention, since it is in the Amazons-drainage; but it is in the most southern extremity of it, close to the divide toward the Paraguay. It certainly requires confirmation.

*New Localities*.—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul,

Brazil (J. D. Haseman coll., February 5. 1909). One specimen, male, with soft parts. Pond along Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11. 1909). Four complete shells, and five isolated valves; of two of these soft parts, males.

*Distribution*.—Drainage of the Rio de la Plata from its mouth and its tributaries in Uruguay and southern Brazil up to the Rio Paraguay in Paraguay. Also reported as crossing the divide, and going into the headwaters of the Amazons in Bolivia. Not known from the Paraná above Corrientes.

This is a species easily recognized by the elongated-subtrapezoidal shape, with the upper and lower margins nearly parallel, by the anterior position of the beaks, by the rather swollen shell and distinct (although rounded) posterior ridge. The sides of the disk are rather flattened, and in this respect this species resembles the *chilensis*-group, intergrading with it to a degree. My specimens are somewhat variable in shape, being longer or shorter. None of them shows the beak-sculpture, since the beaks are badly eroded in all, except in the specimen from Uruguayana, where they are only a little eroded, and consequently a little more elevated. But here also no beak-sculpture can be seen. It must occupy only a very short space near the beaks, hardly more than 5 mm. The specimen from Uruguayana has the naere suffused with red (already mentioned by D'Orbigny).

There is not the slightest question that *U. acutirostris* Lea is an old, much eroded, and somewhat distorted specimen of this species. Haas has already suggested this.

*Anatomy*.—I have only the soft parts of male specimens, but Lea has already described them in the case of his *D. acutirostris*, and has furnished at least some information about the marsupium.

Judging from my material, the anal opening is closed above without forming a supra-anal. Closed part over five times as long as the open, the latter slit-like, short, shorter than the branchial opening. Inner edge of anal indistinctly erenulated. Anal and branchial separated by a solid bridge, running a certain distance inward. Branchial with fine papillae, about three times as long as anal. Mantle-edges not united in front of it. Palpi subtriangular, lower margins convex, posterior margins connected for about one-fourth or one-third of their length.

Gills long and rather narrow. In their posterior part they are of equal width, or the outer one is slightly wider; anteriorly the inner is much wider. The outer is considerably narrowed anteriorly, its anterior end being situated near the highest point of the line of the attachment of the mantle. The inner gill has a straight margin in the middle, and anteriorly it is only slightly narrower, its anterior end

being immediately behind the palpi. Inner lamina of inner gills entirely connected with abdominal sac. Structure of the gills in the male as usual, but the interlaminae tissue is unusually well-developed, forming a rather thick layer chiefly on the inside of the primary limb of the gill; and it has, as usual, short, interrupted interlaminae connections, elongated in the direction of the gill-filaments, which in the middle of the gill are few and far apart, while they are a little more frequent near the ends.

Lea describes the marsupium (of *acutirostris*) as occupying nearly the whole length of the inner gill, but no information is given as regards the finer structure.

Color of foot brown or blackish in the distal part, otherwise the soft parts are whitish.

#### 14. DIPLODON CHARRUANUS (D'Orbigny) (1835).

*Glochidium*: Text-fig. 4g, p. 469.

*Unio charruana* D'ORBIGNY, 1843, p. 606, Pl. 71, figs. 8-11; PILSBRY & RUSH, 1896, p. 81; CORSI, 1900, p. 447, fig. 31.

*Unio faba* (as form of *charruana*) D'ORBIGNY, 1843, p. 606 (text), as *rhuacoica*, Pl. 71, figs. 12-14 (*in tabula per errorem*, see Explanation of plates, p. 704).

*Unio rhuacoica* D'ORBIGNY, 1843, p. 606, Pl. 69, figs. 4, 5; CORSI, 1901, p. 450, fig. 33.

*Unio athiops* LEA, Obs., X, 1863, Pl. 41, fig. 285 (*juv.*).

*Unio parvus* LEA, Obs., XII, 1869, Pl. 33, fig. 77 (*juv.*).

*Diplodon rhuacoicus*, *charruanus*, *athiops*, *parvus*, SIMPSON, 1914, pp. 1242, 1243, 1247, 1256.

*Diplodon hidalgoi* HAAS, 1916, pp. 18, 49, Pl. 1, fig. 1.

*Diplodon parvus* HAAS, 1916, pp. 16, 49.

*Diplodon fortis* MARSHALL, 1917, p. 382, Pl. 52, figs. 1-4.

*Type-locality*.—Small streams from Maldonado and Montevideo to Las Vacas, Uruguay ("Banda Oriental").

*Other Localities*.—Lake Potrero, Maldonado, Uruguay (Pilsbry & Rush); Rio Canelon Grande, Montevideo (D'Orbigny, *rhuacoica*); Dep. Canelones, Uruguay (Corsi); Rio Miguelete, Uruguay (Haas, *hidalgoi*); Rio Negro, Tacuarembó, Uruguay; correctly *S. Fructuosa*, on Rio Tacuarembó, tributary to Rio Negro (Marshall, *fortis*); Uruguay River (Lea, *athiops*).

*New Locality*.—Pond along Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). About twenty-five specimens, seventeen with soft parts, including males and gravid females.

*Distribution.*—Small streams of the "Banda Oriental" in Uruguay, from Maldonado westward, and also in the Rio Negro and the Rio Uruguay.<sup>17</sup>

An extremely variable form, of which I possess a good set from one locality, undoubtedly representing young and adult specimens of the *same* species, so that I am able to give a rather full account of it. It is very evident that different individual phases have been previously described as separate species.

*Characters of Shell.*—Shell of medium size (maximum length according to D'Orbigny, 70 mm.; my largest is 62 mm.), solid and rather heavy. Outline subtrapezoidal, more or less elongated, straight (not oblique), but very variable. The upper margin may be rather straight (chiefly in young ones), or more or less curved (in older ones), with or without a distinct posterior upper angle. The posterior end of the shell is more or less pointed; the position of the point is variable, but generally rather low, and little elevated above the base-line. The lower margin is gently curved, often nearly straight in part (chiefly so in old shells), and never curved up suddenly in its posterior part, but only gently and gradually so, if at all. The posterior end of the shell is thus distinctly more tapering than the rounded anterior end, the posterior point lying rather low. The proportion of height to length of the shell is very variable, ranging from 48 to 65 pr. et.

Valves quite convex and swollen, hardly flattened upon the sides, but more convex anteriorly and over the posterior ridge, which is blunt, but more distinct towards the beaks (and in young shells). Diameter 34 to 50 pr. et. of length. Beaks a little inflated, but not very prominent, located at 21 to 29 pr. et. of length. Beak-sculpture seen only in my youngest specimens, extending not more than 8 mm. from the point of the beak, consisting of about thirteen radial bars, of which only the lower ends are seen. They increase little in length posteriorly, are rather sharp in front, but the longest are somewhat obtuse, while the two last, right upon the posterior ridge, are again sharp and shorter. In some of my specimens, chiefly the younger ones, there are some short, oblique wrinkles (one to eight) upon the posterior slope; in others they are entirely absent. Lunula absent or present, narrow.

Epidermis with numerous, irregular, finer and coarser, concentric lines; the finer ones sublamellar on posterior slope and towards the margin. Radial sculpture obscure, but present in the shape of fine lines, sometimes more distinct on the anterior portion of the shell. Color of epidermis dark olive-green to black.

<sup>17</sup> Von Ihering (1893, p. 102) reports *athlops* from the Guahyba drainage in Rio Grande do Sul, and a variety (*piracicabana*) from the Upper Paraná-drainage in São Paulo, but these records should be doubted.

Old specimens are generally uniformly black; younger ones are dark greenish olive or brownish olive, sometimes with more or less distinct concentric lighter (brownish to yellowish) bands.

Hinge-line gently or more strongly convex. Ligamental sinus over the posterior part of the lateral teeth; in larger specimens over the last fifth. Laterals rather straight in young, curved in older shells, one in right, two in left valve, their edges somewhat rough. Pseudocardinals normally two in right, and one in left valve, but often there is a second (posterior) one in the left valve. These teeth are extremely variable. In younger shells they are compressed and lamellar, directed obliquely forwards; the posterior tooth of the right valve is always thicker and higher than the anterior, and they are, chiefly the former, crenulated or denticulated. In older shells, the posterior tooth of the right, and the (anterior) tooth of the left valve may become thicker, more stumpy, and may be much divided. The posterior tooth of the left valve, if present at all, may be larger or smaller, compressed or stumpy.

Cavity of shell and beaks moderate. Nacre in all my specimens white, iridescent posteriorly. Anterior adductor-scar distinct and impressed; anterior retractor-scar separated from it, small and deep; anterior protractor-scar connected with it. Posterior adductor-scar less impressed, the posterior retractor-scar forming an upper process of it. Pallial line distinct. Dorsal muscle-scars a few, situated in the beak-cavity.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.
14. ....	♂	34 mm.	20.5 mm. = 60 pr. ct. of L.	12 mm. = 35 pr. ct. of L.	at 10 mm. = 29 pr. ct. of L.
12. ....	♂	48 "	26.5 " = 55 "	20 " = 41 "	10 " = 21 "
c. ....	♂	54 "	35 " = 65 "	27 " = 50 "	14 " = 26 "
9. ....	♀	54 "	30.5 " = 56 "	24 " = 41 "	13 " = 24 "
Half shell. ....		58 "	31 " = 53 "	26 " = 45 "	13 " = 22 "
3. ....	♀	61 "	35 " = 57 "	26 " = 42 "	17.5 " = 29 "
z. ....		62 "	35 " = 56 "	27 " = 44 "	15 " = 24 "

For comparison I give here previous measurements.

	Length.	Height.	Diameter.	Beaks.
<i>charruanus</i> , D'Orbigny's text:	70 mm.	61 pr. ct. of L.	45 pr. ct. of L.	
<i>rhuacoicus</i> , D'Orbigny's text:	63 mm.	51 pr. ct. of L.	43 pr. ct. of L.	
<i>faba</i> , (rhuacoicus), D'Orbigny's fig.	43 "	20.5 mm. = 48 "	15 mm. = 35 "	12 mm. = 28 pr. ct. of L.
<i>athlops</i> , Lea's fig.	53 "	28 " = 53 "	18 " = 34 "	12 " = 23 "
<i>parvus</i> , Lea's fig.	36 "	18 " = 50 "	13 " = 36 "	10 " = 28 "
<i>hidalgoi</i> , Haas:	63 "	39 " = 62 "	27 " = 43 "	
	66.5 "	42 " = 63 "	27 " = 41 "	
<i>fortis</i> , Marshall:	66 "	37 " = 56 "	27 " = 41 "	

*Remarks.*—Among our specimens the single valve comes nearest to the measurements given for *U. rhuacoicus*. D'Orbigny himself admits that this may be only a more elongated form of *charruanus*, and his *faba*, united by him with *charruanus*, is even more elongated. There is no reason for keeping *rhuacoicus* separate, since the proportional length is said to be the only difference.

The variations in the shape of the shell are, indeed, very great. Younger specimens are, however, more uniform; they are more elongated, and their normal shape is well rendered in D'Orbigny's figures of *faba* (Pl. 71, figs. 12-14), and in the figures of *athiops* and *parcus*. The latter undoubtedly is a young shell, but *athiops* also belongs here. Specimens like those measured under Nos. 12 and 9 resemble this very much, except that they are a little more swollen, and our smallest (No. 14) looks very much like *parcus*, but it is less elongated.

In the description and the figures of D'Orbigny only the color of the epidermis is not exactly as in our specimens. D'Orbigny describes it in *charruanus* as well as *rhuacoicus* as brownish green, and figures it as lighter or darker brown, while the color of *faba* (Pl. 71, figs. 13, 14) is blackish, agreeing better with our specimens. However, our young specimens have a color, which may be called brownish green, or rather "olive-brown." Lea's *athiops* is said to be black.

The chief characters of this species thus seem to be the subtrapezoidal, rather elongate, straight shell, with a moderately sharp posterior point, located only little above the base-line; the somewhat swollen shell, with a moderate and blunt posterior ridge, and the brown to blackish color of the epidermis. The chief variations are found in the length of the shell, and the somewhat higher or lower position of the posterior end.

There is no question that *hidalgoi* Haas and *fortis* Marshall are this species. The former is founded upon two specimens, the latter upon a single one, which certainly represent individual phases. Specimens greatly resembling these are among my material.

*Anatomy.*—I have the soft parts of eleven males and six gravid females, three with eggs, three with glochidia, one of these discharging.

Anal opening slit-like, closed above, the closed part about four times as long as the opening; the latter shorter than the branchial opening. The two openings are separated by a solid mantle-connection. Branchial with small papillae. Palpi subtriangular, their posterior margins connected near the base. Gills posteriorly of about the same width, but anteriorly the inner is wider, and its anterior end is immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Non-marsupial gills with scattered, short, interlaminar connec-

tions. The *marsupial part* of the female occupies a large portion of the inner gill, leaving about one-fourth of the gill free in front, and a smaller part free behind, thus gravitating slightly toward the posterior part of the gill. The interlaminar connections could not be distinctly observed by me on a lateral view, since no barren females are at hand; but from sections it was possible to infer that they form interrupted septa forming a system of intercommunicating water-tubes. The eggs and glochidia fill the water-tubes and the perforations of the septa in a mass, which is not conglutinated and divided into placentæ.

The *glochidium* (Text-fig. 4g, p. 469) has the characteristic triangular shape, somewhat oblique, with the point situated below the posterior end of the upper margin (like the figure of the glochidium of *U. peculiaris*, See Lea, Obs. XII, 1869, Pl. 34, fig. 80). *This point does not possess a hook.* Size of glochidium: L. 0.31, D. 0.26 mm.

I have examined the glochidia of three specimens; one of these had the marsupium largely empty, and thus it appears to have been discharging. Yet no hooks were seen. But it may be that the discharge in this case was premature, that none of the glochidia were mature, and that the hooks might have developed later. This can be decided only by investigating more material.

#### 15. DIPLODON PICEUS (Lea) (1860).

*Anatomy of gills:* Pl. XLVI, fig. 2; *glochidium:* Text-fig. 4h, p. 469.

*Unio piceus* LEA, Obs., X, 1863, Pl. 41, fig. 287.

*Diplodon piceus* SIMPSON, 1914, p. 1244; HAAS, 1916, pp. 15, 49.

*Type-locality.*—Uruguay River.

*Other Localities.*—Rio Uruguay, Salto Oriental, Uruguay (Haas); Rio Miguelete, Uruguay (Haas).

*Localities Represented in the Carnegie Museum.*—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 5, 1909) eight specimens, seven of them with soft parts, males and gravid females. Arroyo Miguelete, Montevideo, Uruguay (J. D. Haseman coll., February 17, 1909) one specimen.

*Distribution.*—Positively known from the Uruguay River, and from a small coastal stream (R. Miguelete) near Montevideo, and probably more widely distributed in the "Banda Oriental" in Uruguay. It possibly may be only a form of *charruanus*. Corsi does not mention it from Uruguay.

A species closely allied to *D. charruanus*, and very near to it in its dimensions, except that it does not show the same extremes of variation. It is, however,



shorter on the average (H. 59 to 63 pr. ct. of L., while *D. charruanus* varies from 48 to 65 pr. ct.). In addition *D. piceus* is not so subtrapezoidal in outline, but rather subovate, which is brought about by a stronger curve of the lower margin, which ascends much more distinctly posteriorly, so that the posterior end of the shell is more elevated above the base-line. At the same time the posterior end is rather blunt and rounded, and not so pointed as in *D. charruanus*.

All other characters of the shell are similar to *D. charruanus*. The radial sculpture of the epidermis is more distinct. The inside of the shell is also similar, but the pseudocardinals are simpler, always elongate and compressed, and there is always only one in the left valve. They are not much cut up, but only crenulated and rugose. Naere white, though one of my specimens has purplish blue in the cavity, probably a discoloration.

Beak-sculpture, as far as can be seen in smaller shells, similar to that of *D. charruanus*. But there is a very small specimen, which is only 10 mm. long, among them, which is doubtfully referred here. In this case the sculpture consists of fifteen radial bars, of which the eighth and ninth unite at their lower ends. The anterior bars are shorter, but there is not much difference in this respect from the posterior bars. The bars are rather sharp and fine, but those upon the umbonal ridge are slightly thicker, and the two last, upon the posterior slope are very fine and shorter.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.
<i>Uruguayana</i> .					
1.....	♀	30 mm.	19 mm. = 63 pr. ct. of L.	11.5 mm. = 38 pr. ct. of L.	at 8.5 mm. = 28 pr. ct. of L.
2.....	♀	35 "	20.5 " = 59 "	13 " = 37 "	10 " = 29 "
5.....	♂	51 "	31 " = 61 "	21 " = 41 "	15 " = 29 "
4.....	♀	51.5 "	30 " = 58 "	20.5 " = 40 "	15 " = 29 "
7.....	♀	64 "	38 " = 59 "	28 " = 44 "	18 " = 28 "
<i>Montevideo</i> .					
		57 "	35.5 " = 62 "	25.5 " = 45 "	16 " = 28 "
Lea's fig.		47 "	28 " = 60 "	19 " = 40 "	12 " = 26 "

*Remarks.*—There is not the slightest doubt that my specimens represent the *U. piceus* of Lea, but the question of its possible identity with *D. charruanus* must be left undecided, also that of other possible synonyms (*lepidus* Lea, and *firmus* Lea). I cannot unite these for the present on account of certain peculiar structures in the anatomy, which will be pointed out presently.

*Anatomy.*—I have the soft parts of one male, one barren female, and five gravid females, three of the latter with eggs, and two with glochidia, but in one only are the glochidia mature.

The structure is entirely like that of *D. charruanus*. With regard to the mar-

*supium* (Pl. XLVI, fig. 2) it is to be remarked that it occupies in larger specimens a somewhat greater portion of the inner gill, leaving anteriorly as well as posteriorly less than one-fourth of the gill free. In smaller females the marsupial part is relatively smaller. The interlaminar connections form distinct, but interrupted, septa. The connections stand very close, and the septiform structure prevails throughout the marsupium, and very little is seen of a transverse or reticulate arrangement. In some parts, chiefly towards the margin, the septa become more or less continuous. Thus there are here rather distinct, but intercommunicating water-tubes (ovisacs), which are filled, when charged, with masses of eggs connected with each other through the communications, so that no placenta-like arrangement is observed.

*Glochidium* (Text-fig. 4h, p. 469).—Higher and more upright than that of *D. charruanus*; L. and H. about the same, 0.28 to 0.29 mm. Thus it is more like that of *D. firmus* figured by Lea (Obs., XII, 1869, Pl. 34, fig. 82), but not quite as upright. At the point of the lower margin there is a *hook* of the usual shape, about 0.09 mm. long. But such hooks are present in only one of my specimens, in the other the glochidia are too immature.

It would be quite remarkable if in two species, so closely allied as *D. charruanus* and *piccus*, the glochidia should differ so fundamentally, that in one there are hooks, and in the other not. But judging from my material, this is the case. However, it must be emphasized again that my material is scanty, and possibly in the case of *D. charruanus* I do not at all have ripe glochidia.

#### 16. DIPLODON URUGUAYENSIS (Lea) (1860).

*Unio uruguayensis* LEA, Obs., X, 1863, Pl. 45, fig. 298.

*Diplodon uruguayensis* SIMPSON, 1914, p. 1234.

*Unio apprimus* LEA (1866), Obs., XII, 1869, Pl. 33, fig. 78.

*Type-locality*.—Uruguay River.

*New Locality*.—Pond along Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). Five complete specimens, and several odd valves, two specimens (male and female) with soft parts.

*Distribution*.—Known only from Rio Uruguay and Rio Negro.

The synonymy and affinity of this species is obscure. Simpson thinks that it is close to *D. wymani*, but the latter is a compressed shell, while *uruguayensis* is much swollen. *U. apprimus* also is a swollen shell. Lea has already suggested that this is close to *uruguayensis*, but that it differs chiefly in the hinge-teeth,

which are more lamellar and compressed in the latter (a smaller shell), and more stumpy and cut up in *apprimus*. My material shows that the character of the hinge-teeth changes with age. In general my specimens correspond in size and shape to *uruguayensis*, but the larger ones have more stumpy teeth, and thus I believe that *apprimus* is an old specimen of *uruguayensis*. Both Simpson and Haas (1916, p. 12, 47) unite *apprimus* with *wymani*, which cannot be correct on account of the difference in obesity. I think *wymani* belongs to *lacteolus* (See below).

However, it is quite possible that all these forms are variations of one and the same species, and then, of course, our general arrangement must be changed. As regards the present form I can only say that it looks like a very large and heavy *charruanus*, the shell being rather elongated, subtrapezoidal, and much swollen. In *lacteolus*, the shell is higher and more ovate, and much more compressed. In none of my specimens is the beak-sculpture seen.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.
a.....	♂	73 mm.	50 mm. = 68 pr. ct. of L.	31 mm. = 43 pr. ct. of L.	at 19 mm. = 26 pr. ct. of L.
1.....		73.5 "	47 " = 64 "	37 " = 50 "	20 " = 27 "
b.....	♀	78 "	52 " = 67 "	40 " = 51 "	21 " = 27 "
2.....		78 "	52 " = 67 "	33 " = 42 "	19 " = 24 "
c.....		79 "	47.5 " = 60 "	32 " = 41 "	20 " = 25 "
uruguayensis.....		70 "	45 " = 64 "	30 " = 43 "	
apprimus <sup>18</sup> .....		101 "	66 " = 65 "	40 " = 40 "	

*Anatomy.*—Soft parts of a male and a barren female at hand.

Color of soft parts: distal part of foot dark gray, this color sharply marked off from the whitish basal part.

Anal closed above; closed part about four times as long as the open part, which is slit-like, and shorter than the branchial, and separated from it by a solid mantle-connection. Branchial opening with small, but distinct, papillæ. Palpi rather large, subtriangular, with lower margins strongly convex; posterior margins connected at base.

Gills long and moderately wide, the inner one much wider than the outer anteriorly, its anterior end immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Non-marsupial gills with scattered, short, interlamina connections. In the female a large section of the inner gill is *marsupial*, about one-fourth of the gill remaining non-marsupial at the anterior

<sup>18</sup> The measurements of *uruguayensis* and *apprimus* are those given by Simpson for the respective types. Those for *apprimus* are given by him under *wymani* (p. 1231).

end, and less than that at the posterior end. The interlaminar connections of the marsupium are developed as interrupted septa, forming communicating water-tubes. The connections are short, and are also arranged in irregular cross-rows, but towards the edge of the gill, the septiform arrangement is quite distinct.

17. *DIPLODON HILDÆ* Ortmann, sp. nov.

*Shell*: Pl. XXXVI, fig. 7; Pl. XXXVII, figs. 1, 2, 3; *Anatomy of gills*: Pl. XLVI, fig. 3; *Glochidium*: Text-fig. 4i, p. 469.

*Type-locality*.—Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 26, 1909). *Type-set*: Carnegie Museum, No. 61.5864. Fourteen specimens, males, barren and gravid females, soft parts of all in alcohol.

There were six additional specimens in the original lot.

*Description of the Shell*.—Shell rather small (maximum length 46 mm.), rather solid. Outline subelliptical or indistinctly subtrapezoidal, height 57 to 63 pr. et. of length. Upper margin straight or gently convex, forming a blunt angle with the posterior margin. Posterior margin obliquely descending, straight, or gently convex, forming a blunt point with the lower margin; this point situated distinctly above the base-line. Lower margin rather regularly convex, ascending anteriorly and posteriorly, its lowest point situated between beaks and posterior end of ligament (rather median). Anteriorly the margin is regularly rounded. Anterior end of shell not much narrower than the posterior, which tapers to the blunt posterior point, so that the shell is rather regularly elliptical, with the posterior end subpointed, the angle of the posterior upper margin giving a suggestion of the subtrapezoidal shape.

Valves rather regularly convex, greatest diameter slightly behind the middle, but distinctly in front of the posterior ridge, which is very blunt and broad. Posterior slope somewhat compressed, sometimes with a trace of a radial furrow. Sides of disk less convex, but not at all flattened. Diameter 34 to 44 pr. et. of length, so that the shell appears as moderately swollen. Beaks a little inflated, but not very prominent above the hinge-line, located at 23 to 28 pr. et. of the length. Beak-sculpture seen only in the smallest specimens, and only the lower part of it. There are about fourteen radial bars, the anterior rather sharp, the posterior located just in front of the posterior ridge, broader (at least their lower ends) and the latter are a little longer than the former. The last two or three bars are again finer and shorter. The longest bars are about 8 mm. long. There may be fine, short, oblique wrinkles upon the posterior slope, but these are distinct only in a few specimens. Lunula short, very narrow, or practically absent.

Epidermis shining, chiefly so in the middle of the disk and in younger specimens, but with unequal concentric wrinkles and striae, which become somewhat sublamellar on the posterior slope and near the margins. Radial sculpture present, consisting of irregular, often interrupted lines, chiefly upon the anterior part of the shell, often appearing as "scalariform stripes" (radial rows of fine, short, concentric wrinkles). Color of epidermis light to dark brown; in young specimens it is a beautiful, shining, golden brown, lighter in the middle of the shell and towards the beaks (and sometimes here with light greenish shades). In older shells the color is chestnut-brown to dark brown. In some specimens there are indications of darker concentric bands. No traces of color-rays, except one or two very faint dark rays upon the posterior slope (seen only when held up against a strong light).

Hinge-line very gently curved. Ligamental sinus over the posterior fourth or third of the lateral teeth (more posterior in old shells, which shows that the ligament is comparatively longer in them). Lateral teeth gently curved, long, one in right, two in left valve, finely rugose. Pseudocardinals obliquely directed forward and downward, normally two in right, one in left valve, compressed, but not very long, their edges crenulated and serrated. The posterior in the right valve more elevated than the anterior, and often thicker. Sometimes there is a trace of a second posterior tooth in the left valve, but this is always small.

Cavity of shell and beaks moderately deep. Nacre whitish, shining, in the largest specimens the thickest parts (toward the front of the shell) have a faint rosy hue. Muscle-scars of the typical shape; the anterior adductor-scar is rather deep, the retractor-scar separated from it, round and deep, the protractor-scar connected with it; the posterior adductor- and retractor-scars are united. Pallial line distinct. An irregular, longitudinal row of dorsal scars in the beak-cavity.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
d...	♂	25 mm.	14.5 mm. = 58 pr. et. of L.	8.5 mm. = 34 pr. et. of L.	at 7 mm. = 28 pr. et. of L.	Pl. XXXVII, fig. 1.
e...	♀	32.5 "	19.5 " = 60 "	11.5 " = 35 "	7.5 " = 23 "	
k...	♂	37.5 "	23.5 " = 63 "	15.5 " = 41 "	10 " = 27 "	
p...	♀	40 "	24 " = 60 "	16.5 " = 44 "	10.5 " = 26 "	
q...	♂	43 "	24.5 " = 57 "	17 " = 40 "	10 " = 23 "	Pl. XXXVI, fig. 7.
15...	♀	46.5 "	27 " = 58 "	19 " = 41 "	11.5 " = 25 "	Pl. XXXVII, fig. 2.

*Remarks.*—I have been unable to recognize this species in any of the published descriptions. It is a rather beautiful shell; marked by its small size, nearly regularly elliptical outline, with no obliquity, rather swollen valves, and with a peculiar, shining, golden brown color when young. It resembles, to a degree, *D. charruanus*, but differs from it chiefly in size, more regular shape, and the gloss of the epidermis.

Very few species of *Diplodon* are known in Rio Grande do Sul, from the drainage of the Guahyba (to which the Rio Jacuhy belongs) and all have been only incidentally mentioned by Von Ihering (1893). Under *U. athiops piracicabana* (l. c., p. 102) he reports that *U. athiops* is found in the Guahyba River. I have been unable to discover this species, which is identical with *charruanus*, in the material collected by Haseman in this system, and I am sure that the present form is *not* the one which Von Ihering calls *athiops*. From his casual remarks it is seen that the latter has a shallow depression on the disk (l. c., p. 104), and nothing of the kind is seen in *D. hilde*.

*Anatomy*.—I have two barren females, and three gravid females with glochidia. Of the latter, one had only very few glochidia in the marsupium, but some were in the suprabranchial canals, and thus it was evidently discharging. The rest of my specimens are males.

Color of soft parts whitish; distal part of foot grayish black.

Anal opening closed above; closed part about four times as long as the open part, the latter slit-like, slightly shorter than the branchial; the latter has small, but distinct papillæ. Anal and branchial openings separated by a solid mantle-connection. Palpi moderate, subtriangular, posterior margins connected at base.

Gills long and rather wide. They are about equally wide posteriorly, but the outer is subtriangular and narrows anteriorly, while the inner does not, and remains as wide as posteriorly, with its anterior end immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac. The non-marsupial gills with scattered interlaminar connections. In the female, the *marsupium* (Plate XLVI, fig. 3) is located in the inner gill, but anteriorly about one-third of the gill remains non-marsupial, posteriorly much less, about one-fifth of it or less, so that the marsupial part is located distinctly more backward in the gill, occupying about half of its length. When charged, the marsupium forms a slightly swollen patch. In young specimens the marsupium is smaller. Interlaminar connections in the marsupium forming septiform rows, with a tendency to fall also into irregular transverse rows. The transverse arrangement prevails near the base and in the middle of the gill, here and there with a suggestion of a quincuncial disposition; the septiform arrangement is found toward the margin of the gill.

*Glochidium* (Text-fig. 4i, p. 469) subtriangular, longer than high, with a ventral point, slightly oblique, the point being vertically under the posterior end of the upper margin. There are *no hooks*. In one of my specimens, the glochidia are not margined (not mature); in the two others they are *margined*, with a narrow

rim around the anterior-lower-posterior margin, representing, apparently, the first rudiments of the postembryonal shell. Size (without rim): L. 0.29 to 0.30; H. 0.26 mm.; (with rim): L. 0.34 to 0.35; H. 0.28 to 0.29 mm.

The hookless glochidium, provided with a rim or margin, is highly interesting in view of the fact, that this structure has not been observed in other species of the *charruanus*-group.

#### 5. GROUP OF *Diplodon luteolus*.

Like the fourth group (that of *charruanus*), but shell higher and shorter, subtrapezoidal to ovate, chiefly so when young, compressed or somewhat swollen. Beak-sculpture fine or a little heavier and better developed, but not covering a large part of the shell.

This group stands close to that of *D. charruanus*. The greater height of the shell is chiefly evident in the young shell, which may be slightly oblique. But the older shells are also shorter and higher than in the species of the *charruanus*-group, although they generally are less elevated than younger shells. They are not oblique, and have a rather regular, broadly ovate, or subelliptical outline.

#### 18. *DIPLODON BURROUGHIANUS* (Lea) (1834).

*Anatomy of gills*: Plate XLVI, fig. 4.

*Unio burroughianus* LEA, Obs., I, 1834, Pl. 10, fig. 27; D'ORBIGNY, 1843, p. 609;

VON MARTENS, 1894, p. 164; CORSI, 1901, p. 450.

*Diplodon burroughianus* SIMPSON, 1914, p. 1271.

*Type-locality*.—Rio Paraná, Province of Corrientes, Argentina.

*Other localities*.—Small rivers of the Banda Oriental in Uruguay (D'Orbigny); Montevideo (D'Orbigny); swamps along the Paraná from Buenos Aires to above Corrientes (D'Orbigny); Paraguay (Von Martens).

It also occurs near Santa Cruz de la Sierra in Bolivia (D'Orbigny) which is in the drainage of the Amazons.

*New Locality*.—Pond near the Rio Negro, Santa Isabel, Uruguay (J. D. Hase-man coll., February 11, 1909). Three complete specimens, two of them, male and female, with soft parts, and four odd valves.

*Distribution*.—Drainage of Rio de la Plata, including the small streams of the Banda Oriental, Rio Negro, and the Paraná and Paraguay to Paraguay, and possibly also in the Amazon-drainage in Bolivia. The latter part of the range, however, should be confirmed.

Some of my specimens, chiefly the female with soft parts, agree very well with

*burroughianus* in shape, dimensions, and color. Others differ more or less, chiefly in having the posterior point of the shell less elevated above the base-line. Thus they approach other species described by Lea as *piger* (1860) and *ampullaceus* (1869), both from the Uruguay River (See also *ampullaceus*, Haas, 1916, pp. 11, 47). My material is not sufficient to work out the synonymy.

## MEASUREMENTS.

Sex.	Length.	Height.	Diameter.	Beaks.
♀	54 mm.	38 mm. = 70 pr. et. of L.	23.5 mm. = 44 pr. et. of L.	at 13 mm. = 24 pr. et. of L.
♂	56.5 "	39 " = 73 "	27.5 " = 49 "	15 " = 27 "
	60 "	44 " = 73 "	26 " = 43 "	16 " = 27 " (Lea's figure)
	100 "	62 "	44 "	(D'Orbigny)
	94 "	64 " = 68 "	40 " = 43 "	(Von Martens)
	88 "	58 " = 66 "	35 " = 40 "	(Simpson)
	71 "	43 " = 61 "	26 " = 37 "	Do.

The two specimens measured by Simpson do not include the type. They are more compressed than any others.

*Anatomy.*—The soft parts of a male and a female are at hand.

Color of soft parts whitish, distal part of foot grayish.

Anal opening slit-like, closed above, short, shorter than the branchial opening, separated from the latter by a connection of the mantle-margins. Branchial opening short, its inner edge with small, but distinct papillæ. Palpi subtriangular, moderately large, lower margins convex, posterior margins united at base for a short distance.

Gills of the usual shape; the inner the wider, chiefly in front, its anterior end close behind the palpi. Structure of non-marsupial gills as usual. Marsupial portion in the female (Pl. XLVI, fig. 4) located in the inner gill, leaving about one-third at the anterior end, and about one-fifth at the posterior end free, so that the marsupium distinctly gravitates toward the posterior part of the gill. Interlaminar connections arranged in interrupted septa, and irregular, transverse rows, here and there quineuneial. This irregularly reticulate structure prevails throughout the marsupium, and the septiform arrangement is obscure.

19. *DIPLODON LACTEOLUS* (Lea) (1834).

See: *Diplodon lacteolus* (LEA) and *D. wymani* (LEA) (1860) SIMPSON, 1914, p. 1226, 1230.<sup>19</sup>

<sup>19</sup> Lea himself (1834, p. 90) has identified the type of Lamarek's *U. delodonta* (1819) with his *lacteolus* (1834, p. 40), but not until after the latter name had been published in a satisfactory way, while the original description of *delodonta* is absolutely unidentifiable. Thus, according to the rules, *lacteolus* must be used, as Simpson has done.



The following references should be added to those given by Simpson.

*Unio delodonta* D'ORBIGNY, 1843, p. 605; Corsi, 1901, p. 449.

*Diplodon wymani* HAAS, 1916, pp. 12, 47.

As to the synonymy compare Simpson. His *D. wymani* only in part belongs here. *D. apprimus* Lea, united by him with *wymani*, is different (more swollen, see above p. 512). On the other hand, I cannot distinguish the real *wymani* from *lacteolus*, and Von Ihering (1893, p. 117) also unites them.

*Type-locality*.—Rio de la Plata.

*Other Localities*.—Stream, Villa del Cerro, Montevideo, Uruguay (D'Orbigny); Rio Uruguay (Lea, *wymani*); Rio Uruguay, Las dos Hermanas Islands, Uruguay (D'Orbigny); Rio Uruguay, Salto Oriental, Uruguay (Haas); Rio San Salvador (trib. to Uruguay), Soriano, Uruguay (Corsi); Buenos Aires (D'Orbigny); Rio Batel and Rio Corrientes, Province of Corrientes, Argentina (D'Orbigny).

*New Localities*.—Pond near Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). One specimen, young. Brooklet, two miles north of the City of La Plata, Argentina (Dr. W. J. Holland coll., September 24, 1912). Two specimens.

*Distribution*.—Lower La Plata and Paraná systems, upward to the province of Corrientes; also in the lower Uruguay and Rio Negro, and small tributaries of the La Plata in Argentina and Uruguay.

My specimens from La Plata are typical. The young specimen from Santa Isabel is interesting in having a rather high shell, which is slightly oblique, but comparison with the other specimens shows that, according to the growth-rests, the latter had the same shape when young. This young shell also exhibits the comparatively heavy beak-sculpture, with the radial bars running down the shell about 13 to 15 mm. Traces of these are also seen in my larger specimens.

#### MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
Santa Isabel .....	50 mm.	36.5 mm. = 73 pr. ct. of L.	18 mm. = 36 pr. ct. of L.	at 13 mm. = 26 pr. ct. of L.
La Plata .....	85 "	61 " = 72 "	32 " = 38 "	21 " = 25 "
Do. ....	87 "	63 " = 72 "	34 " = 39 "	22 " = 25 "
<i>lacteolus</i> (Lea's figure) .....	80 "	51 " = 64 "	31 " = 39 "	23 " = 29 "
Do. (Acc. to Simpson) .....	80 "	50 " = 63 "	30 " = 38 "	
Do. ....	72 "	42 " = 58 "	26 " = 36 "	
Do. ....	83 "	56 " = 67 "	35 " = 42 "	
<i>delodontus</i> (D'Orbigny) .....	85 "	70 "	38 "	
<i>wymani</i> (Lea's figure) .....	75 "	49 " = 65 "	28 " = 37 "	19 " = 25 "

The first measurements given by Simpson apparently refer to the type of *lacteolus*, although they do not fully agree with Lea's figure. The second measure-

ments given by him belong to a specimen which is exceptionally low. The measurements given by Simpson for *wymani* do not belong to this species, but to *apprimus* (See above, p. 513, footnote 18).

I have a suspicion that *D. felipponei* Marshall (1917, p. 381, Pl. 50, figs. 1-3, Pl. 51, fig. 1) from Maldonado and other places in Uruguay, is also this species. The height as given is 70 to 72 pr. et. of the length, and the general shape and other particulars agree, as for instance the hinge-teeth. But, according to the figure, *felipponei* is less pointed behind, and the diameter is a little greater (40 to 46 pr. et. The color also (yellowish-chestnut) is not exactly like *lacteolus*, which has chestnut-olive-green tints. Thus I leave this question undecided.

## 20. DIPLODON MOGYMIRIM Ortmann, sp. nov.

*Shells*: Pl. XXXVII, figs. 4, 5, 6, 7; *Anatomy of gills*: Pl. XLVI, fig. 5; *Section of gills*: Pl. XLVIII, fig. 2; *Glochidium*: Text-fig. 4k, p. 469.

*Type-locality*.—Creek near Mogy Mirim, São Paulo, Brazil, tributary to Rio Mogy Guassú and Rio Grande, upper Paraná-drainage. J. D. Haseman coll., August 28, 1908. *Type-set*: Carn. Mus. Cat. No. 61.9260, fourteen specimens, males, barren and gravid females, all with soft parts. (The original lot contained over one hundred specimens.)

Of all the species of *Diplodon* known from the upper Paraná-drainage in São Paulo only one described by Von Ihering resembles this in shape: *Unio greeffeanus* (Von Ihering, 1893, p. 96, Pl. 4, fig. 8). However, the color of the epidermis of the latter is described as being dark green to blackish, and this does not at all fit our specimens, which are brownish black, without any distinct greenish tints. Moreover, the dimensions given for the two specimens described by Von Ihering, although falling within the range of variation of my specimens, are rather extreme, and do not represent the normal condition of our species. The height is 61 and 64 pr. et. of the length, while in my material this proportion varies from 62 to 74 pr. et.; and the diameter is 34 and 33 pr. et., while it ranges, in my specimens, from 32 to 42 pr. et. *U. greeffeanus* comes from the Piracicaba River (Campinas and Piracicaba), while our specimens belong to the Rio Grande drainage.

From the latter, and especially from Rio Mogy Guassú, at Jaboticabal (not "Taboticabal" as printed), Simpson (1914, p. 1250) has described *Diplodon trivialis*. Dimensions and description agree with our specimens to a degree; but again the color is different, being described as black or dark brown, and tinted green when rubbed, while in our specimens, when rubbed (cleaned), the epidermis is of a peculiar

golden brown, without green. Also the epidermis is not at all "cloth like," as described in *trivialis* (when fresh), and the description of the pseudocardinals of the left valve does not agree at all. There are said to be two pseudocardinals, the anterior one sometimes feeble, while in our specimens there is generally only one well-developed, and this is the anterior, and if there is a smaller second pseudocardinal, this is the posterior. The figures of *trivialis* given by Marshall (1917, p. 386, Pl. 54, figs. 5-8) show also that the outline is different, being evenly rounded behind. Among my numerous specimens there is not a single one which shows this character, and thus I cannot identify them with *D. trivialis*.

*Description of Shell.*—Of moderate size (maximum length 68 mm.), rather solid. Outline short subelliptical or subovate, or subrhomboidal, when young. Height from 62 to 74 pr. et. of length. Upper margin nearly straight when young, more or less curved when old, in the first case forming an angle with the obliquely and rather steeply descending posterior margin, in the latter case passing into it more or less gradually. Posterior margin gently concave, straight, or gently convex, forming a rounded angle with the lower margin, which may be more distinct in older shells. This posterior point is more or less elevated above the baseline. Lower margin gently and regularly curved, in older shells more nearly straight in the middle. Anterior end of shell slightly narrower than the posterior in young shells; in old shells this may be reversed. Thus the shell is, when young, more subrhomboidal, with an upper posterior angle (somewhat subulate), and, when old, the shell becomes subelliptical or subovate, with the posterior end a little tapering.

Valves rather regularly and evenly convex, sides not distinctly flattened. Greatest diameter a little anterior to the middle. Posterior ridge present, but rounded and indistinct, often (chiefly in young specimens) marked by a shallow radial groove running down the posterior slope, which thus appears as compressed and slightly elevated toward the upper-posterior margin (subulate). Diameter 32 to 42 pr. et. of the length, so that the shell is rather compressed. Beaks not inflated and not much elevated, located at from 25 to 31 pr. et. of the length. Beak-sculpture consisting of fine and short radial bars, hardly more than 5 mm. long, fifteen to eighteen in number, those in the middle converging at their lower ends (one or two pairs). They are hardly longer upon the posterior ridge, and not appreciably thicker. A few oblique wrinkles may be present upon the posterior slope. In most cases the beak-sculpture is entirely obliterated by erosion of the beaks, and in general it is fine, short, and poorly developed. Lunula present, narrow in young specimens, wider in old ones, but very variable.

Epidermis somewhat shining, with unequal, irregular, concentric wrinkles, more crowded and sublamellar upon the posterior slope and near the margins, chiefly in older shells. Radial sculpture may be present, but indistinct, visible chiefly upon the anterior part of the shell as "scalariform" stripes. Color of epidermis from yellowish brown to dark brown and blackish, but without any distinct traces of greenish tints. In young specimens, when well cleaned, the color is generally yellowish or golden brown in the middle of the disk, shading to chestnut-brown toward the ends and margins. Older shells are more uniformly chestnut-brown to blackish brown (often coated with a dull black-brown deposit). Slight traces of darker brown concentric bands are rarely present.

Hinge-line generally distinctly curved. Ligamental sinus over the posterior half or third of the laterals, generally very indistinct in old specimens. Lateral teeth curved (less so in young shells), moderately long, one in right, two in left valve, their edges and sides corrugated in old shells. Pseudocardinals directed obliquely downward and forward, compressed and lamellar, thin in young shells, thicker in old ones. The right valve has nearly always two of them, equally high, but the anterior narrower. The left valve has mostly only one; but there may be a small and short posterior one, and even a small and narrow anterior one. In one specimen (one out of over one hundred), the pseudocardinals are exactly reversed: one in right, two in left valve, while the laterals are normal. The edges of the pseudocardinals are rugose and crenulated, but not dissected.

Cavity of shell and beaks moderate. Naere whitish, but very generally partially discolored, with irregular yellowish, brownish, or grayish spots. Anterior adductor-scar impressed, rounded or subtriangular; anterior retractor-scar separated from it, rounded or irregularly oval, impressed, but not remarkably deep; anterior protractor-scar connected with adductor-scar. Posterior adductor-scar ovate or subtriangular, less deeply impressed; posterior retractor-scar generally separated from it, but sometimes only indistinctly so. Pallial line distinct. Dorsal scars few and irregular, in beak-cavity, forming an indistinct longitudinal row.

## MEASUREMENTS.

No.	Sex.	Length.		Height.		Diameter.		Beaks.		Figured.
49...	♂	31	mm.	22	mm. = 71 pr. ct. of L.	11	mm. = 35 pr. ct. of L. at	8.5	mm. = 27 pr. ct. of L.	Pl. XXXVII, fig. 6.
12...	♂	39	"	26.5	" = 68 "	12.5	" = 32 "	11	" = 28 "	
18...	♀	40.5	"	30	" = 74 "	15	" = 37 "	11	" = 27 "	Pl. XXXVII, fig. 5.
9...	♂	53	"	36	" = 68 "	20	" = 38 "	13.5	" = 25 "	
41...	♀	63	"	39	" = 62 "	26	" = 41 "	17	" = 27 "	
5...	♀	64.5	"	40	" = 62 "	27	" = 42 "	17	" = 26 "	
34...	♀	68	"	43	" = 63 "	25.5	" = 38 "	21	" = 31 "	
16...	♀	68	"	45	" = 66 "	26	" = 38 "	18	" = 26 "	

*Remarks.*—This species somewhat resembles *D. lacteolus*, but is considerably smaller, has finer and shorter beak-sculpture, and, when old, has more simple, less dissected pseudocardinals, of which those of the right valve are more nearly equal. The young shell (Pl. XXXVII, fig. 6a) has rather a subrhomboidal shape, exactly as *D. lacteolus*, which is due to the better development of the angle between the upper and posterior margins, which appears as slightly elevated (alate). Thus the young shell is slightly higher in its posterior section, with the posterior end of the shell less elevated above the base-line, giving to the whole shell a slightly oblique appearance. But this juvenile shape is sooner or later obliterated, the posterior wing disappearing, and the posterior end becoming more tapering, giving to the shell a rather subovate outline, with the posterior end subpointed; but this point is never very distinct. The outline of Von Ihering's *greeffeanus* (Pl. 4, fig. 8) comes very near to the normal shape of the old shell of *D. mogymirim*. The brownish color of the epidermis of our species is also characteristic, and the complete absence of distinctly greenish tints is to be noted.

*Anatomy.*—I have a great number of the soft parts of males and of barren and gravid females, the latter partly with eggs, partly with glochidia in various stages of development. Of fifty specimens the anatomy has been investigated more closely. For the breeding season the date of collection (August 28) should be noted.

Color of soft parts brownish white.

Anal opening slit-like, closed above; closed part not quite twice as long as the open part. Anal about as long as the branchial, separated from it by a solid mantle-connection. Branchial opening with distinct papillae. Palpi moderate, subtriangular, posterior margins connected for about one-third of their length.

Gills (Pl. XLVI, fig. 5a, b, c) rather wide, the outer one subtriangular, posteriorly slightly wider than the inner; the inner one subtrapezoidal, anteriorly wider than the outer, its anterior end immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Non-marsupial gills (Pl. XLVI, fig. 5a) with few, scattered interlaminar connections. The *marsupium* (Pl. XLVI, fig. 5b) of the females located in the inner gills, but occupying only a part, anteriorly leaving free not quite one-third of the gill, and posteriorly hardly one-fourth, so that the marsupium gravitates slightly toward the posterior section of the gill. In young females, the marsupial part (Pl. XLVI, fig. 5b) is much smaller, and lies distinctly behind the middle of the gill. Structure of the marsupium (Pl. XLVI, fig. 5c and Pl. XLVIII, fig. 2a, b) quite peculiar, consisting of *uninterrupted septa*, forming well isolated water-tubes. An interrupted or reticu-

lated arrangement of the interlaminar connections is nowhere to be seen. Nevertheless this structure must be regarded as developed out of the interrupted condition of the septa, since the non-marsupial gills distinctly show the latter (Pl. XLVI, fig. 5c). In consequence of the development of the water-tubes, the egg-masses fill these tubes (the ovisacs) in placenta-like bodies (conglutinated); however, these are not very solid and persistent.

Glochidium (text-figure 4k, p. 469) subtriangular, longer than high, rather small. L. 0.29, H. 0.23 mm. They are slightly oblique, with the lower point vertically under the posterior third of the hinge-line. They have hooks of the usual shape, about 0.09 mm. long. Immature glochidia have no hooks.

21. DIPODON SUAVIDICUS (Lea) (1856).

*Unio suavidicus* LEA, Obs., VI, 1857, Pl. 29, f. 24.

*Diplodon suavidicus* SIMPSON, 1900, p. 876; 1914, p. 1240.

*Type-locality*.—River Amazon.

*New Locality*.—Rio Tapajos, Santarem, Pará, Brazil (J. D. Haseman coll., December 6–12. 1909). Six specimens and three isolated right valves.

*Description*.—Shell small, greatest L. 28 mm., moderately solid, angularly subovate or subtrapezoidal, but little oblique, slightly narrower in front, somewhat broader and sub-pointed behind. Height 69 to 76 pr. et. of length. Valves not gaping; dorsal margin gently curved, descending posteriorly, anteriorly descending more steeply, and passing insensibly into the anterior margin, posteriorly passing in a rather distinct (indistinct only in largest specimens) but blunt angle into the posterior margin, which descends obliquely, and is straight or very gently curved. Lower margin ascending gently in its posterior part, and meeting the posterior margin in a more or less distinct, but rounded, angle, forming the posterior point of the shell, which is a little elevated above the base-line. Anterior part of lower margin longer, sloping distinctly upward. It may be almost straight, or very gently curved, curving up into the anterior margin. Thus the anterior part of the shell appears somewhat narrower than the posterior.

Valves moderately convex, slightly flatter on the sides. Umbonal ridge rather distinct, but rounded. Posterior slope compressed, produced in young specimens into a slight wing-like elevation of the posterior angle of the upper margin. In some specimens there is a bare indication of a radial rib upon the posterior slope. Diameter 43 to 50 pr. et. of length. Beaks not much swollen, little elevated above hinge-line, located at 22 to 29 pr. et. of length. Beak-sculpture rather well developed, extending upon the umbonal ridge about 10 mm. or more,

but not quite so far upon the rest of the shell, and covering altogether about one-third or one-fourth of the shell. There are about fifteen or sixteen radial bars, of which the eighth and ninth unite, and between the latter there is another shorter pair, also united in v-shape. These bars are rather sharp, those just in front of the umbonal ridge are hardly broader. The most anterior bars are sometimes slightly granular, occasioned by the growth-lines cutting across them. There are generally close to the beaks a few additional radial bars upon the posterior slope, and below then some oblique, irregular wrinkles, sometimes crossing the former, so as to form v-shaped angles (forming the posterior system of re-entering angles of Lea). Lunula present, short, narrower or wider.

Epidermis with numerous, fine, concentric growth-lines, sublamellar on posterior slope, and in the larger specimens with traces of radial lines, chiefly in the front part of the shell. Color brown to blackish brown, without color-markings.

Hinge-line gently curved. Ligamental sinus over the posterior third of the laterals. Lateral teeth gently curved, thin, one in right, two in left valve. Pseudocardinals obliquely descending, rather long, compressed and thin, two in right valve, the posterior more elevated, with serrated edge. In the left valve also two pseudocardinals, the anterior larger, serrated, the posterior much smaller, sometimes rudimentary.

Cavity of shell and beaks moderate. Nacre whitish. Anterior adductor-scar moderately impressed. Anterior retractor-scar separated, and anterior protractor-scar united with adductor-scar. Posterior scars indistinct, united. Dorsal scars in beak-cavity.

## MEASUREMENTS.

No.	Length.	Height.	Diameter.	Beaks.
1.....	18 mm.	13 mm. = 72 pr. ct. of L.	9 mm. = 50 pr. ct. of L.	at 4 mm. = 22 pr. ct. of L.
2.....	18.5 "	14 " = 76 "	9 " = 49 "	5 " = 27 "
4.....	21 "	15 " = 71 "	9 " = 43 "	6 " = 29 "
5.....	25 "	18 " = 72 "	11.5 " = 46 "	7 " = 28 "
5a.....	27 "	18.5 " = 69 "	12 " = 44 "	7.5 " = 28 "
6.....	28 "	20 " = 71 "	12 " = 43 "	8 " = 29 "
Lea's figure.	21 "	15 " = 71 "	9.5 " = 45 "	5 " = 24 "

*Remarks.* My specimens are rather uniform in shape and proportions. There is some variation in the posterior part of the ventral margin, which may ascend a little more decidedly, giving to this margin a more distinct lower projection, and placing the posterior point of the shell a little higher above the base-line. In my largest specimen, all angles (upper posterior, posterior, and that of lower margin) are more rounded. The beak-sculpture may be more or less distinct and sharp, and the bars vary somewhat in length.

Previously this species was known only from a single individual described by Lea. There is not the slightest doubt that my specimens belong here, and one of them (No. 4) is almost a replica of that of Lea. Lea believes that his shell is a young one, and it certainly is not full-grown, but, as my material shows, this species does not grow very much larger. Von Ihering (1893, p. 120) suggests that this might be the young stage of *U. wheatleyanus* Lea, but this cannot be the case, since the latter has a different, much heavier beak-sculpture.

I am uncertain about the systematic position of this species, but there are certain resemblances in the shape of the shell to that of the *lacteolus*-group. This species is also interesting because of the fact that it is one of the few forms of *Diplodon* found in the Amazon-drainage.

#### 6. GROUP OF *Diplodon ellipticus*.

Shell more or less elongated, but often rather high and short; subovate or subtrapezoidal, distinctly oblique at all stages of growth, with the longest axis forming an angle with the line of the ligament. Anterior end narrower, posterior end higher, and lower margin distinctly ascending in its anterior portion. Beak-sculpture fine or coarse, more or less developed.

The chief character of this group is the *obliquity* of the shell, brought about by a widening of the posterior portion of the shell in the vertical direction, so that the posterior end lies rather low, and the longest dimension is not parallel or nearly parallel to the ligament, but forms a distinct angle with it. Although an obliquity is sometimes indicated in the species of the previous groups, it generally disappears with increasing age, while in the present group the obliquity is rather emphasized in older shells. It is all-important, in order to correctly judge as to the shape of these shells, to place them in a uniform position, always with the ligament running horizontally.

The outline of the shells of this group varies a good deal, and some of them become very high in proportion to length, so that the outline appears more nearly subrotund, similar to the shape in the subgenus *Cyclomya*. However, in the latter the greatest height of the shell is always situated more nearly in the middle under the middle of the ligament, while in the shells of the *ellipticus*-group the greatest height is more posteriorly, at the posterior end of the ligament, or even beyond that.

#### 22. *DIPLODON ELLIPTICUS* Spix (1827).

*Diplodon ellipticum* (error typogr.) SPIX, 1827, Pl. 26, fig. 1-2.

*Unio ellipticus* WAGNER, 1827, p. 33; VON IHERING, 1890, p. 163, Pl. 9, figs. 8-9;

Von Ihering, 1893, p. 108.



*Diplodon wagnerianum* SIMPSON, 1900, p. 877; 1914, p. 1246.

*Type-locality.* Rio San Francisco (Wagner).

*Other Localities.*—Rio Parahyba do Sul, Rio de Janeiro (Von Ihering, 1893, p. 115); Rio Santa Maria, Espírito Santo (Von Ihering, 1910, p. 134) (drainage of Rio Doce). The form from the latter locality has been named var. *santanus* Von Ihering.

Rio Piracicaba, São Paulo, and Rio Tamanduatahy, São Paulo (Von Ihering). The latter two localities are somewhat doubtful, since the specimens are not exactly like *ellipticus*. The location and drainage of the last named river is unknown to me.

In the Carnegie Museum is one specimen, labeled "Brazil" (Holland Collection). Not quite typical.

The change of the specific name *ellipticus* to *wagnerianus* is unwarranted. Spix gave the name in the plate in connection with the generic name *Diplodon*. Since the latter stands, the specific name also is entitled to recognition.

In spite of Von Ihering's re-description of the type, this species is as yet poorly known, and our knowledge of it is founded chiefly upon what Von Ihering has said. The species is positively known from the Rio San Francisco and the Rio Parahyba do Sul; the other localities are more or less doubtful, since the specimens described from them do not fully agree with the type. Those from the Rio Santa Maria have been distinguished as a variety.

All we can gather from descriptions and figures is that *D. ellipticus* is a sub-elliptical or subtrapezoidal shell, of dark green to blackish color, with rather smooth surface. It has in the anterior part of the shell a shallow depression, often producing a shallow emargination in the anterior part of the ventral margin. In outline, the shell is distinctly oblique, narrower in front, higher behind. The beak-sculpture consists of simple, fine radial bars, which are rather short, and somewhat cut up on the posterior slope by irregular, oblique wrinkles. The nacre is bluish white. Pseudocardinals somewhat compressed, but not thin, crenulated, two in right, one in left valve, but the latter with an angle at its base, representing the remnant of a posterior tooth.

Our specimen from Brazil was received as *ellipticus*. It agrees in most of the above characters, except that it is shorter in proportion to height, with less pointed posterior end. Also the projection of the lower margin is indistinct. The beak has eleven radial bars in front of the posterior ridge, the seventh and eighth meeting in the middle. On the posterior slope there are corrugations and fine, oblique ridges. L. 32 mm.; H. 21 mm.; D. 12 mm. This specimen might very well be

a young *ellipticus*, and may correspond to the var. *santanus* of Von Ihering (smaller, projection of lower margin less distinct).

23. *DIPLODON BERTHÆ* Ortman, sp. nov.

*Shells*: Plate XXXVIII, figs. 1, 2, 3, 4; *Anatomy of gills*: Plate XLVI, fig. 6.

*Type-locality*.—Rio Jacuhy, Cachocira, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 26, 1909). *Type-set*: Carn. Mus. Cat. No. 61.5865. Sixteen specimens, all with soft parts, including males, barren and gravid females. (There were twenty-three specimens in the original lot).

*Additional Locality*.—Rio Vaccahy Mirim, Santa Maria, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 29, 1909). One male with soft parts.

*Distribution*: Guahyba drainage in southern Brazil.

*Description of Shell*.—Shell rather small, maximum length 65 mm.; rather solid, chiefly so anteriorly, and in old shells often much thickened along the lower anterior margin. Outline subovate to subtrapezoidal, distinctly oblique, broad and rounded, or somewhat pointed behind. Height from 55 to 67 pr. et. of length. Valves not gaping. Dorsal margin straight, or gently descending posteriorly, forming a more or less distinct obtuse angle with the posterior margin. The latter obliquely descending, gently convex, and curving around into the posterior part of the lower margin, forming with the latter in young specimens an indistinct rounded angle, which, however, may become more distinct in old specimens. Lower margin in normal specimens with a distinct rounded projection, forming the lowest point of this margin, situated far back, behind the posterior end of the ligament. From this point the lower margin curves up behind to the posterior end of the shell and this part is quite short. Anteriorly the lower margin also slopes upward, and is almost straight for a considerable distance; sometimes it is even slightly concave; then it curves up into the anterior margin. Thus the shell appears considerably narrower anteriorly, broader (higher) posteriorly, with the greatest height situated far backward.

Valves moderately and not uniformly convex. The greatest convexity is near the anterior end and over the posterior ridge, which is broad and not sharply marked. In front of the posterior ridge the sides of the disk are distinctly and broadly flattened, and sometimes even slightly concave, producing the emargination of the anterior part of the lower margin. Posterior slope somewhat compressed, very rarely with a slight trace of a rib or a furrow. Greatest diameter of the shell 32 to 43 pr. et. of the length, located well behind, upon, or close in front of, the posterior ridge. Thus, although rather swollen in the region of the posterior ridge,

the shell appears in front of it rather more compressed. Beaks not much swollen, and not very prominent, located at from 23 to 29 pr. et. of the length. Beak-sculpture consists of twelve to fourteen radial bars, which are sharp and rather distant from each other, the ninth, tenth, and eleventh (immediately in front of and upon the posterior ridge) are longest, about 10 to 12 mm. long; the seventh and eighth may consist of two bars united in V-shape, but this cannot be seen clearly, since in all specimens the tips of the beaks are eroded. These median bars (seventh and eighth) are also slightly shorter than those in front, and distinctly shorter than those behind them; the last two or three bars are fine and somewhat shorter, and stand upon the posterior slope, becoming indistinct. In a few of my specimens there are traces of oblique wrinkles upon the posterior slope. Lunula short and narrow, distinct only in larger specimens.

Epidermis smooth, rather shining, with numerous, closely set, fine, concentric lines, and stronger and irregular concentric wrinkles. The fine lines become sublamellar on the posterior slope and towards the margins. A fine radial sculpture is present, chiefly in the anterior part of the shell, but it is not very evident. Color greenish black to brownish black, darkest in old shells. Young shells are more distinctly greenish, dark olive-green, shading towards the beaks to gray-green and brownish olive. There are no distinct color-bands and no distinct color-rays, except in very young specimens, where there are traces of dark green rays on the posterior slope, seen when held up against a strong light.

Hinge straight or gently curved. Ligamental sinus over the posterior third or fourth of the laterals (more posteriorly in old shells). Lateral teeth curved, more strongly so in their posterior part in old shells, one in right, two in left valve, edges rugose. Pseudocardinals two in right, one in left valve, subcompressed, not very long, in old specimens sometimes almost stumpy. The posterior pseudocardinal of right valve stronger and more elevated than the anterior, often much divided, and always much crenulated. Very often there is a second posterior small pseudocardinal in the left valve.

Cavity of shell and beaks shallow. Nacre whitish, in old specimens often very thick anteriorly, and with pinkish tints; posteriorly very iridescent. Adductor-sears deeply impressed anteriorly, less so posteriorly. Anterior retractor-scar small and deep, separated from the adductor-scar; anterior protractor-scar united with it. Posterior retractor-scar connected with adductor-scar. Pallial line distinct. Dorsal sears in an oblique irregular row in the beak-cavity.

*Remarks.*—This species may be what Von Ihering (1893, p. 102) calls *athiops* in the Guahyba drainage, but only the remark (p. 104) that this *athiops* has a

broad, shallow furrow in the anterior part of the shell, seems to confirm this assumption. In other respects it is impossible to decide, whether this is, or is not, the *athlops* of Von Ihering. It surely is *not* the *athlops* of Lea. Of the few other species incidentally mentioned by Von Ihering as found in the Guahyba-drainage, none can be compared with our species. Its chief characters are the subovate to subtrapezoidal distinctly oblique shape, narrow in front, broader behind, and the peculiar compression of the shell in the anterior part. The beak-sculpture and color of the epidermis are also characteristic.

## MEASUREMENTS.

No.	Sex.	Length.	Height.		Diameter.		Beaks.		Figured.
3...	♂	31.5 mm.	21	mm. = 67 pr. et. of L.	10	mm. = 32 pr. et. of L.	at 8	mm. = 25 pr. et. of L.	Pl. XXXVIII, fig. 2.
11...	♂	43.5 "	27.5	" = 63 "	18	" = 41 "	12.5	" = 29 "	
14...	♀	47 "	31.5	" = 67 "	19	" = 40 "	12.5	" = 27 "	
22...	♀	51.5 "	32	" = 62 "	22	" = 43 "	12	" = 23 "	
23...	♀	52 "	29	" = 56 "	21.5	" = 41 "	12	" = 23 "	
24...	♂	56 "	36	" = 64 "	21.5	" = 38 "	13.5	" = 24 "	Pl. XXXVIII, fig. 1.
34...	♂	65 "	35.5	" = 55 "	26	" = 40 "	15	" = 23 "	(Santa Maria)

I cannot compare this species with any other, except *D. ellipticus* Spix. The general shape is very much the same, but *ellipticus* seems to be more elongate (height only 54 pr. et. of length). The posterior end is slightly more pointed, and the diameter is distinctly less (31 pr. et. on the average). In our species the average height is 62 pr. et. and the diameter 39 pr. et. In addition our shell seems to be thicker and more solid, chiefly in old specimens, where the lower anterior margin is considerably and strikingly thickened, a character not mentioned in *ellipticus*.

Old shells often become freakish, assuming irregular shapes. Frequently the posterior part of the shell grows more strongly in length, thus rendering the shell exceptionally long (as in No. 23). In such specimens the projection of the lower margin is obscured, and the posterior point of the shell is very little elevated above the base-line. Furthermore the shell in general is more pointed behind. Such specimens also appear more swollen. However, the growth-lines clearly indicate that, when young, these individuals had the normal shape. In other old shells the whole posterior part is more developed (No. 24, Pl. XXXVIII, fig. 1a) and is deflected downward. This fact tends to preserve the general shape, but renders the anterior part of the lower margin somewhat concave.

*Anatomy.*—Judging from the soft parts at hand, twelve specimens are males, five are barren females, and seven are gravid females. Only one of the latter contained immature glochidia. The date of collection (January 26) apparently is near the beginning of the breeding season.

*Color*.—Distal part of foot dark brownish, grayish, or blackish; the rest of the soft parts are whitish.

Anal opening closed above; the closed part about four times as long, or a little longer than the open part; the latter slit-like, slightly shorter than the branchial opening. The latter with small, but distinct papillæ, separated from the anal by a solid mantle-union. Palpi subtriangular, moderately large, of the usual shape; their posterior margins connected at base.

Gills rather long and wide. Outer gill subtriangular, widest at the beginning of the posterior third, and here it projects a little beyond the inner gill. Inner gill subtrapezoidal, its anterior end immediately behind the palpi. Inner lamina of inner gill connected with abdominal sac.

Structure of non-marsupial gills as usual. In the female, the *marsupium* (Pl. XLVI, fig. 6) is located in the inner gill, and in large specimens it is restricted to the middle part of the gill, leaving non-marsupial almost one-third at the anterior end, and a somewhat smaller portion at the posterior end. In young specimens the marsupium is smaller. When charged, the marsupium forms a slightly swollen, lenticular, rounded, or oblong patch in the middle of the gill, most of it lying behind the middle. The interlaminar connections of the marsupium are strongly developed, forming very incomplete, interrupted septa, and arranging themselves rather in transverse and oblique rows, so that the vertical septiform structure is obscure, while a reticulate and irregularly quincuncial arrangement prevails. Only near the margin of the gill is a septiform structure indistinctly indicated. The egg-masses do not conglutinate into placenta-like structures.

Only one of my females has very young *glochidia*. They are, as far as can be seen, of the usual shape, subtriangular, and somewhat oblique. Exact measurements could not be obtained. No hooks are visible, but, of course, such may be present in ripe glochidia.

#### 24. *DIPLODON ENNO* Ortmann, sp. nov.

*Shells*: Plate XXXVIII, figs. 5, 6, 7, 8; *Anatomy of gills*: Plate XLVI, fig. 7.

*Type-locality*.—Rio Grande, Boqueirão, Bahia, Brazil (S. Francisco drainage). (J. D. Haseman coll., January 9, 1908). *Type-set*: Carn. Mus. Cat. No. 31.9264. Eighteen specimens, males and barren females, with soft parts. (A number of additional young specimens were in the original set.)

According to the latest census of the *Naiades* from the Rio S. Francisco drainage (Von Ihering, 1910, p. 138), there are only two species of *Diplodon* present in this system: *D. rotundus* Spix, and *D. ellipticus* Spix. The former is much

higher and much more rounded than the present species; the latter is more elongated and more pointed behind, and has, besides, a smooth epidermis (*Cf.* Von Ihering, 1890, p. 163). Since it is impossible for me to find any other South American species of *Diplodon*, the description of which answers to the present species, we must regard the latter as new.

*Description of Shell.*—Shell small to medium (maximum length 53 mm.), rather thin. Outline subovate or subtrapezoidal, distinctly oblique, higher behind, narrowed anteriorly, the obliquity being most pronounced in older specimens. Height 56 to 75 pr. et. of length (against 54 pr. et. in *ellipticus*, and 86 or 87 pr. et. in *rotundus*). Valves not gaping. Dorsal margin straight or gently convex, forming a rather distinct or obtuse angle with the posterior margin, which descends obliquely and rather steeply, is nearly straight or gently convex, and curves into the lower margin without forming a distinct posterior point. The posterior extremity of the shell is located relatively low and is only moderately elevated above the base-line. Lower margin with its lowest point located rather posteriorly, vertically below the posterior end of the ligament, or even behind it, strongly ascending in a curve toward the posterior end of the shell, but nearly straight or very slightly convex in its anterior part, and sloping upward toward the anterior margin, so that the anterior portion of the shell is distinctly narrower than the posterior, producing thus the oblique appearance of the whole shell.

Valves comparatively compressed. Diameter 28 to 45 pr. et. of length. Greatest convexity and greatest diameter situated well back upon the posterior ridge, which, however, is very indistinct and broad. Sides of the shell in front of posterior ridge not very convex and rather flattened. Posterior slope compressed, sometimes with a faint trace of a radial groove, somewhat elevated (wing-like) toward the upper posterior angle. Beaks not swollen, and hardly elevated above the hinge-line, located at from 22 to 28 pr. et. of the length. Beak-sculpture sharp and fine, distinct, but restricted to the region near the beaks. There are fifteen to eighteen radial bars, the ninth and tenth in the middle, joined and v-shaped at their lower ends. The longest bars (6 to 8 mm.) stand upon the posterior ridge, the anterior ones being distinctly shorter. There are a few anterior bars and upon the posterior slope a few posterior bars, and sometimes traces of oblique wrinkles. None of the bars are distinctly granular, and a comparatively slight degree of erosion obliterates all traces of beak-sculpture. Lunula indistinct and narrow, visible only in older shells.

Epidermis not shining, but rather rough. This is due to a great number of fine, irregular, concentric lines, which, when well-preserved, are lamellar and

elevated, showing this character all over the disk, being, however, more distinctly lamellar and more crowded upon the posterior slope and near the margins. Even when these fine lamellæ are worn off, the epidermis does not become shining, but remains dull, and when well-preserved, the epidermis appears cloth-like. There are no traces of radial sculpture. Color of epidermis dark greenish black, but often in the middle of the disk and towards the beaks brownish black. The greenish tint is not very evident, and is best seen in young specimens.

Hinge-line very gently curved. Ligamental sinus over the posterior third of the laterals. Lateral teeth curved, one in right, two in left valve, their edges slightly corrugated or nearly smooth. Pseudocardinals narrow and compressed, but not very long, corrugated and rugose, but not cut up, two well developed pseudocardinals of nearly equal size in right valve, one well-developed in left valve; but there often is a smaller posterior one in the left valve, and another small, low, and narrow anterior one, so that the left valve may have three pseudocardinals. The middle one, however, is always the largest. Sometimes the posterior pseudocardinal of the right valve is higher and thicker than the anterior.

Cavity of shell and beaks shallow. Nacre bluish silvery, very iridescent, and sometimes discolored yellowish. Anterior adductor-scar distinct and moderately impressed. Anterior retractor-scar rounded, small and rather deep, separated from adductor-scar. Anterior protractor-scar united with it. Posterior adductor-scar rather indistinct and not impressed, the posterior retractor-scar forming an upper process of it. Pallial line not very sharp. Dorsal scars few in beak-cavity.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
18...	?	12.5 mm.	7 mm. =56 pr. et. of L.	3.5 mm. =28 pr. et. of L.	at 3.5 mm. =28 pr. et. of L.	
14...	?	22 "	13.5 " =61 "	7 " =32 "	6 " =27 "	
8...	♂	28 "	20.5 " =73 "	9 " =32 "	7 " =25 "	
4...	♂	35 "	26 " =74 "	12 " =34 "	8 " =23 "	Pl. XXXVIII, fig. 5.
2...	♀	45 "	32 " =71 "	16.5 " =37 "	10 " =22 "	Pl. XXXVIII, fig. 8.
1...	♀	53 "	40 " =75 "	24 " =45 "	12.5 " =24 "	Pl. XXXVIII, fig. 7.

*Remarks.*—The dimensions of this species change slightly with age, in that younger shells are not so high in proportion, and consequently, they appear less distinctly oblique than older ones. The diameter of young shells is also less than in old ones, and the highest figures (37 to 45 pr. et.) are shown by old females. In other respects my specimens are rather uniform, and the oblique, not very elongated shape, and the dull, blackish epidermis and silvery nacre are chiefly characteristic.

*Anatomy*.—It was not possible to positively ascertain the sex of my smallest specimens. But, I have other specimens, of which five are positively males, and seven of which are females. None of the latter were gravid.

Color of soft parts whitish, distal part of foot brown.

Anal opening closed above; closed part considerably longer than the open part; the latter slit-like, shorter than the branchial opening, and separated from it by a solid mantle-connection. Branchial opening with distinct papillæ. Palpi subtriangular, their posterior margins connected for about one-third of their length.

Gills of the usual shape, rather wide, the inner anteriorly wider, its anterior end close to the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Non-marsupial gills of the usual structure, with few and scattered interlaminal connections. *Marsupium* of the female (Pl. XLVI, fig. 7b) located in the inner gill, occupying nearly half of it in the middle, leaving non-marsupial one-fourth of the gill both at the anterior and posterior end. In young females the marsupial part is smaller (Pl. XLVI, fig. 7a), but also located nearly centrally. Interlaminal connections of the marsupium reticulated or quincuncial toward the base, but forming interrupted septa toward the margin.

## 25. *DIPLODON GRATUS* (Lea) (1860).

*Section of gills*: Plate XLVIII, fig. 3.

*Unio gratus* LEA, Obs., X, 1863, Pl. 43, fig. 290; SOWERBY, XVI, 1868, Pl. 84, fig. 444.

*Diplodon (Cyclomya) gratus* SIMPSON, 1900, p. 886.

*Diplodon (Cyclomya) fontainianus gratus* SIMPSON, 1914, p. 1281.

*Type-locality*.—Rio Uruguay.

*New Locality*.—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 5, 1909) twenty-one specimens, males and females, all with soft parts.

*Distribution*.—Positively known only from the Uruguay River. Von Ihering (1893, p. 92) gives this form also from Rio Guahyba, Porto Alegre, Rio Grande do Sul. However, as we shall see, this is not the typical *gratus*, and the Guahyba-form has already been distinguished by Simpson as var. *deceptus* (see below).

*Description of Shell*.—Rather small, maximum length of my specimens 53 mm., moderately thick. Outline obliquely subrotund, subovate, or subtrapezoidal, very variable, more or less high (height 72 to 85 pr. et. of length). There is an indistinct relation of the shape to sex, in so far that the highest shells (79 pr. et. and over in height) are all males, while the more elongated specimens may be either



males or females, the former being more subrotund, the latter more subovate-subtrapezoidal. Dorsal margin gently convex, forming a more or less distinct, obtuse angle with the posterior margin, the latter obliquely descending, straight, or gently curved, curving broadly around into the lower margin, forming the indistinctly defined, rounded, posterior end of the shell. Lower margin ascending in its anterior part, gently curved in the higher shells, or almost straight in those more elongated, its posterior part curving up towards the posterior margin. The lowest point of the lower margin (and greatest height of shell) is located well backward, vertically below the posterior end of the ligament, or even behind this. Thus the shell presents a rather oblique shape, being narrowed anteriorly, and higher posteriorly, but, according to the varying height, this obliquity is more or less pronounced, most distinctly in the more elongated shells, less so in those more elevated, where the outline approaches the subrotund shape.

Valves moderately but variably convex, convexity greatest upon the broad posterior ridge, smallest upon the sides of the disk, where elongated specimens are almost flat. Posterior slope slightly compressed, sometimes with a trace of a radial furrow and a ridge, which, however, may be entirely obliterated. Diameter 36 to 50 pr. et. of length. The more compressed specimens are the smaller, but no distinct relation to sex can be discovered in this. Beaks moderately swollen, not very prominent, located at 25 to 34 pr. et. of the length (more anteriorly in larger specimens). Beak-sculpture weakly developed, seen only in smaller specimens, consisting of twelve to thirteen radial bars, of which the seventh and eighth unite v-shapedly. The bars do not differ much in length, although the posterior ones are slightly longer, the maximum being hardly over 8 mm. long. They are not very sharp, but rather blunt, only the most anterior and posterior (upon posterior slope) are somewhat finer and sharper. Often there are upon the posterior slope irregular oblique wrinkles, which may be rather numerous, or may be altogether absent. Lunula absent in young, but sometimes seen in older specimens, short and very narrow.

Epidermis smooth in the middle of the disk, but not very shining, covered with numerous somewhat irregular, fine, concentric lines, and more widely separated irregular concentric wrinkles. The concentric lines are sublamellar upon the anterior end, the posterior slope, and towards the margin, and sometimes they are sublamellar all over the disk, but the latter is the case only in young individuals. In old specimens they undoubtedly have been worn off. Radial sculpture generally present. It may be very obscure, chiefly in younger shells, but is visible in older shells, consisting of faint, blunt radial ridges, which are rather irregular, often in-

terrupted, and more distinct in the anterior part of the shell. Even when best developed, they do not constitute a prominent feature of the surface. Color of epidermis dark olive-green to blackish. In young specimens it is more grayish or brownish green towards the beaks; in older specimens it appears nearly black. When slightly worn, it is in places lighter, brownish olive, or greenish olive. In some older specimens brownish tints appear towards the lower margin, and sometimes a faint brownish concentric band is indicated. The general impression of the color of the epidermis, however, is blackish green, not brown. No color-rays are visible.

Hinge-line gently curved. Ligamental sinus over the posterior third of the laterals, in young specimens over the posterior half. Lateral teeth curved more strongly in their posterior part in old shells, one in right, two in left valve, their edges rough. Pseudocardinals directed obliquely forwards and downwards, lamellar and compressed, but not very long. In the right valve there are two of them, the posterior much larger than the anterior. In the left valve there is one pseudocardinal, but quite often a smaller posterior one is present. All pseudocardinals are rough, crenulated, or serrated.

Cavity of shell and beaks moderate. Nacre whitish, iridescent, in young shells blueish or greenish silvery towards the edges. In older shells it becomes more opaque white, and assumes generally a creamy or salmon hue in and near the cavity. In a few specimens there is a very delicate pinkish tint all over the nacre.

Anterior adductor-scar rather deep, subelliptical; anterior retractor-scar small, deep, isolated from the adductor-scar; anterior protractor-scar connected with it. Posterior adductor-scar subtriangular, faintly impressed, posterior retractor-scar forming an upper triangular process of it. Pallial line distinct. Dorsal scars few, in an irregular, oblique line in the beak-cavity.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.
b. . .	?	23.5 mm.	17 mm. = 72 pr. ct. of L.	8.5 mm. = 36 pr. ct. of L.	at 7.5 mm. = 32 pr. ct. of L.
2. . .	?	28.5 "	23.5 " = 85 "	11 " = 39 "	9 " = 32 "
3. . .	?	32 "	23.5 " = 73 "	14 " = 44 "	11 " = 34 "
7. . .	♀	36 "	26 " = 72 "	13.5 " = 38 "	11 " = 31 "
13. . .	♂	37.5 "	32 " = 85 "	16.5 " = 44 "	10 " = 27 "
10. . .	♂	39 "	29 " = 74 "	16 " = 41 "	11.5 " = 29 "
16. . .	♂	40 "	32.5 " = 81 "	20 " = 50 "	11.5 " = 29 "
14. . .	♀	41 "	32 " = 78 "	18 " = 44 "	12.5 " = 30 "
22. . .	♂	47 "	39.5 " = 84 "	20 " = 43 "	12 " = 26 "
21. . .	♀	50 "	36 " = 72 "	21 " = 42 "	14 " = 28 "
Half shell. .		53 "	38 " = 72 "	22 " = 42 "	13 " = 25 "

*Remarks.*—According to Simpson (1914), this form (*gratus*) is a variety of *D. fontainianus* (D'Orbigny), and there is no doubt that both are closely allied to each other. However, Simpson erroneously gives the distribution of *fontainianus* as: "Uruguay River and its affluents; Paraná River, southern Brazil," while it is known only, according to D'Orbigny and Von Ihering (1893) from the Rio Parahyba, Rio de Janeiro, the upper Paraná-drainage in São Paulo, and Lagoa Santa in Minas Geraes (Rio de las Velhas, São Francisco-drainage). In 1910 (p. 138) Von Ihering drops this latter locality. *Fontainianus* has never been reported from the Uruguay. Thus it is not very likely that my specimens from this river are *D. fontainianus*, although they agree with it in some particulars.

According to Von Ihering's account of *D. fontainianus* (1893, p. 90, Pl. 4, fig. 6), the latter differs from my specimens chiefly in having the posterior retractor-scar separated from the adductor-scar, but otherwise they are very similar. This holds good chiefly in the color of the epidermis. My specimens are greenish black, which agrees best with Von Ihering's *D. fontainianus*, which is "black, with greenish basis," and to a degree with D'Orbigny's "brun noirâtre," while Lea describes his *gratus* as "dark olive brown." The differences between *D. gratus* and *D. fontainianus*, as given by Simpson, concern the shape of the shell, which is said in *gratus* to be more wedge-shaped in front, and the texture of the epidermis, which is said to be smoother, subshining, and lighter in color. These differences I cannot recognize in my specimens. It is therefore hard to decide by which name they should be called. However, my specimens coming from the Uruguay River, being practically topotypes of *gratus*, I have concluded to call by this name, and, in order to avoid any misunderstanding, I have given a full description of them.

Von Ihering (1893) believes that he has discovered sexual differences in the shell of *D. fontainianus*, the males being higher and shorter, and more rounded, the females being longer and more subtrapezoidal. Similar differences in shape are also noticed in our *D. gratus*. I have seventeen specimens in which the sex has been positively ascertained by examination of the gills, and I find that it is not possible to accurately determine the sex according to the shape of the shell. First of all, the two shapes are not sharply separated, but pass insensibly into each other, many specimens being intermediate between the two extremes. Besides, if form has any relation to sex, we may say that the highest shells (with the height of 79 pr. et. of length and over) are, indeed, males; but among the others, having the height of 72 to 78 pr. et. of length, there are as many females as males, and this applies both to larger and smaller shells. It is true, that the average height of all my males is about 78 pr. et., and the average height of all my females is 75 pr. et.; but

these differences are so slight, that they do not furnish an exact criterion for the distinction of the sexes.

*Anatomy*<sup>20</sup>.—The soft parts of eleven males and six females have been investigated.

Color of distal part of foot blackish, this color sharply set off from the pale basal part. Rest of soft parts whitish. Outer edge of anal opening (including the closed part) and of branchial, black; this color running forward beyond the branchial opening for a short distance.

Anal opening closed above; closed part much longer than the open, the latter slit-like, a little shorter than the branchial opening, and separated from it by a solid mantle-connection. Branchial opening with small, but distinct papillæ. Palpi rather large for the size of the species, subtriangular, with curved lower margin; posterior margins connected only at base.

Gills moderately long and rather wide. Outer gill with strongly convex lower edge, its widest part a little back of the middle, and about as wide as the inner gill in its posterior part. Anteriorly it becomes narrower, and its anterior end is near the highest point of the mantle-attachment-line. Inner gill with the inner lamina entirely connected with abdominal sac, its edge nearly straight in the anterior part, where it is much wider than the outer gill. Anteriorly it is slightly narrowed, and its anterior end is immediately behind the palpi. Structure of non-marsupial gills (Pl. XLVIII, fig. 3a) somewhat unusual, with rather crowded, irregular interlaminal connections, forming weak, interrupted septa; these connections are more frequent toward the margins of the gills. Inner gill of the female *marsupial*. Its interlaminal connections (Pl. XLVIII, fig. 3b) are more crowded, and heavier, arranged in interrupted rows running parallel to the gill-filaments, forming incomplete septa. The marsupium occupies only a part of the gill, leaving a small section at the anterior end free, a somewhat larger one (but hardly one-fourth) at the posterior end free also, so that the marsupium is located in the middle of the gill, and slightly more anteriorly than posteriorly.

In this species, the structure of the marsupial and non-marsupial gills is more alike than usual as regards the arrangement and frequency of the interlaminal connections, but in the marsupium the connections are decidedly heavier and stronger, and form more distinct, although interrupted, septa (See Pl. XLVIII, figs. 3a and 3b).

<sup>20</sup> The anatomy of *D. fontainianus* has been discussed by Von Ihering (1893, p. 90), but the finer structure of the marsupium has not been described. The glochidia are said to be subtriangular, without hooks. Their length is 0.4 to 0.5 mm. Thus they are unusually large for the genus, and belong to the largest known among all *Naiades*.

## 26. DIPLODON DECEPTUS (Simpson) (1914)

*Shells*: Plate XXXIX, figs. 1, 2, 3, 4, 5; *Anatomy of gills*: Plate XLVII, fig. 1;

*Section of gills*: Plate XLVIII, fig. 4.

*Unio gratus* VON IHERING (*non* LEA), 1893, p. 92.

*Diplodon (Cyclomya) fontainianus deceptus* SIMPSON, 1914, p. 1281.

*Type-locality*.—Guahyba, Brazil.

*Other Locality*.—Rio Guahyba, Porto Alegre, Rio Grande do Sul, Brazil (Von Ihering).

*Localities Represented in Carnegie Museum*.—Rio Guahyba, Porto Alegre, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 24, 1909) two shells and one right valve (*Topotypes*). Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 26, 1909) ten specimens with soft parts, males and females.

*Distribution*.—Drainage of the Rio Guahyba and its tributary, the Rio Jacuhy, in Rio Grande do Sul.

There is no question that my specimens belong to the form called by Von Ihering *gratus*, and by Simpson *deceptus*. Von Ihering compares his *D. gratus* with *D. fontainianus*, and says that the former much resembles the latter in shape, but that the epidermis of *D. gratus* is brown, shows radial sculpture, and is smoother; that the beaks are more anterior (24 to 31 pr. et., average 27 pr. et., against 29 to 39 pr. et., average 34 pr. et. in *D. fontainianus*); that the pseudocardinals of *D. gratus* are shorter and more stumpy; and that the posterior retractor-sear is always connected with the adductor-sear.

All these characters hold good for my specimens, and they distinguish this form also from the real *D. gratus* of the Uruguay River, except that the location of the beaks does not differ so much (in true *D. gratus* it is 25 to 34 pr. et.).

Simpson's *D. deceptus* has been described as being unevenly obovate, subinflated, rather solid; pseudocardinals shorter, more stumpy, and much split. This also fits the present form, and I have no doubt that *D. deceptus* is the same shell as that called *D. gratus* by Von Ihering.

The chief differences between *D. deceptus* and *D. gratus* are the following:

1. *D. deceptus* has a greater tendency toward the obliquely elongated shape, with subtrapezoidal or subovate outline. The height varies from 65 to 78 pr. et. of the length, while in *D. gratus* it ranges from 72 to 85 pr. et.

2. The epidermis of *D. deceptus* is always brownish, with hardly any green in it, and not blackish green. It is smoother, since the fine concentric lines are not

lamellarly elevated (except indistinctly so near the margins), and the radial sculpture is more distinct, consisting of faint furrows, becoming often subscalariform toward the margins.

3. The pseudocardinals of *D. deceptus* are more stumpy, chiefly in larger specimens. In younger ones this difference is not so marked, yet noticeable, when individuals of the same size are compared. In large specimens they are short and thick, chiefly so the posterior one of the right valve, and the anterior of the left (Pl. XXXIX, figs. 1c, 1d). The posterior one of the left valve generally is well developed, although smaller than the anterior one. All these teeth are split up into a number of denticles, and there are frequently accessory teeth, anteriorly in the left, and posteriorly in the right valve.

All other characters are as in *D. gratus*, but *D. deceptus* grows to a larger size.

## MEASUREMENTS.

No.	Sex	Length.	Height.		Diameter.		Beaks.		Figured.				
Cachoeira													
1...	?	28	mm.	19	mm. = 68	pr. et. of L.	9	mm. = 32	pr. et. of L.	at 8 mm. = 29	pr. et. of L.		
4...	♂	43	"	33	" = 77	"	18.5	" = 43	"	13	" = 30	"	Pl. XXXIX, fig. 3.
6...	♀	47.5	"	35	" = 74	"	19	" = 40	"	15	" = 31	"	Pl. XXXIX, fig. 4.
8...	♂	56	"	39.5	" = 71	"	22.5	" = 40	"	14	" = 25	"	
11...	♂	62	"	40	" = 65	"	27.5	" = 44	"	17	" = 27	"	Pl. XXXIX, fig. 2.
9...	♀	64	"	43	" = 67	"	26	" = 41	"	17	" = 27	"	
Porto Alegre													
2...		49	"	37	" = 76	"	18.5	" = 38	"	12	" = 24	"	
4...		55	"	43	" = 78	"	26	" = 47	"	13	" = 24	"	

*Remarks.*—In this species we also observe higher and more elongated shells, nevertheless no relation between shape and sex is apparent. In fact, the most elongated specimen No. 11, H. 65 pr. et. (See Pl. XXXIX, fig. 2) is a male, and not, as might be expected (according to Von Ihering) a female. Altogether the number of individuals with the sex positively known is rather small, but the gradual transition of the more elongated into the shorter and higher ones is evident.

*Anatomy.*—From Cachoeira, I have the soft parts of three young specimens, of which the sex is not determined, and five males, and four barren females.

*Color* of the distal part of the foot dark gray, this color sharply marked off from the whitish basal part. The rest of the soft parts whitish.

Anal opening closed above; the closed part about four times as long as the open, which is slit-like, shorter (about three-fourths) than the branchial opening, and separated from the latter by a solid mantle-connection. Branchial opening short, with small, but distinct, papillæ. Palpi rather large, subtriangular, lower margins strongly convex, posterior margins with a short connection at base.

Gills long and wide, posteriorly of about the same width, but anteriorly the inner is wider. Outer gill with margin curved, much narrower anteriorly, its anterior end near the highest point of the mantle-attachment-line. Margin of inner gill nearly straight in the middle, anteriorly this gill is a little narrowed, its anterior end immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac.

Non-marsupial gills with scattered, short, interrupted interlaminar connections, elongated in the direction of the gill-filaments. The *marsupium* of the female (pl. XLVII, fig. 1) is in the inner gill, leaving free a small anterior and posterior section, about one-fourth in front, and a little more behind, so that the marsupium is located in the middle of the gill, but slightly more anteriorly. The interlaminar connections (See also pl. XLVIII, fig. 4) are developed as rather regularly interrupted septa, forming intercommunicating, incomplete water-tubes. In the middle and at the base of the marsupium, the connections fall also into irregular transverse lines, with a suggestion of quincuncial arrangement. In young females, the marsupial part of the inner gill is considerably smaller.

It should be noted that the non-marsupial gills in this species are more nearly normal than in *D. gratus*.

#### 27. *DIPLODON ROTUNDUS* Spix (1827).

*Diplodon rotundum* and *Unio rotundus* SPIX & WAGNER, 1827, p. 34, Pl. 25, figs. 3, 4. *Unio rotundus* SOWERBY, XVI, 1868, Pl. 72, fig. 369; VON IHERING, 1890, p. 169, Pl. 9, fig. 10; 1910, p. 139.

*Diplodon (Cyclomya) rotundus* SIMPSON, 1900, p. 886; 1914, p. 1282.

*Type-locality*.—Southern Brazil.

*Other Localities*.—Rivers of eastern Brazil (Von Ihering, 1890); Rio S. Francisco, Villa Nova, Sergipe, Brazil (VON IHERING, 1910); Rio Paraguassú, Bahia, Brazil (VON IHERING, 1893, p. 115; 1910); Rio Parahyba do Sul, Rio de Janeiro, Brazil (VON IHERING, 1893, p. 115).

*New Locality*.—Rio S. Francisco, Bom Jesus da Lapa, Bahia, Brazil (J. D. Haseman coll., December 17, 1907). Two odd right valves.

In the Carnegie Museum there is another, complete specimen from the Hartman collection without locality.

*Distribution*.—Known from the lower and middle part of the Rio S. Francisco, Rio Paraguassú, and Rio Parahyba do Sul in eastern Brazil.

According to the descriptions given by Von Ihering and Simpson my specimens belong here, but my material is too scanty to give a full account of the species.

However, it should be said that of all species of the group this one most nearly approaches the circular outline. It has been placed by Simpson, for this reason, in the subgenus *Cyclomya*, but, as has been indicated already by Von Ihering, there are specimens with the anterior part of the ventral margin less convex. The figures of the type (Spix and Von Ihering) clearly show the oblique shape of the shell, with the highest part more posterior, at, or behind, the posterior end of the ligament; and there is thus no question that this species falls into the same group with *fontainianus* and *gratus*.

Von Ihering (1893, p. 93) emphasizes the separation of the anterior protractor-scar from the adductor-scar. In my specimens, this separation is not so distinct, but only partial, so that we must not lay too much stress upon this character.

## MEASUREMENTS.

Loc.	Length.	Height.	Depth.	Beaks.	Greatest Height.
Bom Jesus. 44 mm.	38 mm. = 86 pr. et. of L.	20 mm. = 45 pr. et. of L.	at 11 mm. = 25 pr. et. of L.	at 27 mm. = 61 pr. et. of L.	
? 55 "	48 " = 87 "	22.5 " = 41 "	12.5 " = 23 "	34 " = 62 "	
Bom Jesus. 66 "	57 " = 86 "	32 " = 48 "	15 " = 23 "	41 " = 62 "	
(V. Iher. 1890). 38 "	32 " = 84 "	16 " = 42 "	10 " = 26 "		

According to Von Ihering (1910, p. 139), this species reaches the length of 75 mm.

Subgenus: *CYCLOMYA* Simpson (1900).

As has been stated, I restrict this subgenus to those shells which have a subrotund outline, with the greatest height located at about the middle of the shell, that is to say, vertically below the middle of the ligament. The posterior part of the shell is thus rather short, the shell is not obliquely subtrapezoidal, as in the species of the *ellipticus*-group, but rather pentagonal in outline. The species at hand is rather large and heavy, and belongs to the largest forms known in the genus.

28. *DIPLODON (CYCLOMYA) PARANENSIS* (Lea) (1834).

*Shells*: Plate XXXIX, figs. 6, 7.

*Unio paranensis* LEA, Obs. I., 1834, Pl. 14, fig. 42; D'ORBIGNY, 1843, p. 603;

SOWERBY, XVI, 1866, Pl. 51, fig. 268; CORSI, 1901, p. 451.

*Diplodon (Cyclomya) paranensis* SIMPSON, 1900, p. 887; 1914, p. 1284.

*Unio nocturnus* LEA, Obs. X, 1863, Pl. 42, fig. 288.

*Diplodon (Cyclomya) nocturnus* SIMPSON, 1914, p. 1285.

*Unio paraguayanus* VON MARTENS, 1895, p. 34.

*Type-locality*.—Rio Paraná.



*Other Localities.*—Rio Uruguay (D'Orbigny) (*Lea, nocturnus*); Rio Paraná up to above Corrientes (D'Orbigny); Rio Paraguay (Von Ihering, 1893, p. 119); Rio Paraguay, 25° S. Lat. (Von Martens) (This is near Asunción, Paraguay).

*New Localities.*—Rio Paraguay, Corumbá, Matto Grosso, Brazil (H. H. Smith coll.). One large complete shell, one small left valve. In swamp of Lamaré, five miles below Asunción, Paraguay (J. D. Haseman coll., March 31, 1909). One right, one left valve. Rio de la Plata, San Isidro, Argentina (20 km. North of Buenos Aires) (A. Windhausen coll., January 1917). Five specimens with soft parts, males and barren females.

*Distribution.*—Rio de la Plata, Paraná, and Paraguay, from near Buenos Aires up to Matto Grosso, Brazil; Rio Uruguay.

*Description of Shell.*—Shell solid and rather thick, large (length up to and over 100 mm.). Outline angularly rounded, or broadly ovate, little oblique. Height generally over 80 pr. et. of the length, rarely less (lowest figure known 76 pr. et., but this stands rather isolated, being found in a specimen measured by Simpson). Valves closed, or very little gaping in front. Dorsal margin gently curved or straight (when young), descending anteriorly and passing into the anterior margin, without forming a distinct angle. Posteriorly the dorsal margin forms a more or less distinctly rounded angle with the posterior margin. The latter descends obliquely and is straight, or even a little concave; then it curves around in a sharp curve into the postero-ventral margin, this curve forming a blunt posterior point of the shell, well elevated above the basal line. The ventral margin has a sharp curve near its middle, forming a blunt, projecting angle at, or a little behind, the middle of the shell. The highest part of the shell is at 50 to 60 pr. et. of the length. This ventral angle is generally distinct, but may be indistinct. From this projection the lower margin slopes upward in either direction, backward and forward, but the anterior part ascends more strongly, and is longer than the posterior, and is often almost straight part of the way, before it finally curves up into the anterior margin. The shell thus appears somewhat narrower anteriorly than posteriorly, and has a rounded pentagonal shape, the five angles being formed by: 1, the beaks; 2, the upper posterior angle; 3, the posterior end; 4, the middle of the lower margin; 5, the anterior end.

Valves not much swollen, moderately convex over the disk, but slightly flattened on both sides of a submedian more convex ridge. The latter runs toward the projection of the lower margin, but is very faintly marked. Posterior ridge rather distinct on account of a distinct radial depression behind it. This depression makes the posterior slope much compressed, like a narrow wing. The slight

emargination of the posterior margin corresponds to this depression. Diameter 40 to 46 pr. et. of the length (according to Lea's figure a little less, about 38 pr. et.) Beaks not swollen, and very slightly prominent beyond the hinge-line. Beak-sculpture variable, but always more or less heavy, covering from 15 to 27 mm. of the shell. There are about a dozen or more radial bars in front of the posterior ridge, of which the anterior and posterior ones are narrow, while those in the middle are thick and blunt. These ridges are very irregular; some anastomose, smaller ones may be intercalated between the larger ones, or they may be connected laterally. In some specimens the beak-sculpture is much less developed, but traces of the heavy ridges are always visible. Toward the lower margin, the beak-sculpture, when well developed, stops suddenly. In addition, there are upon the posterior slope a number of fine, oblique wrinkles, but these are only well-developed in young individuals. In the larger specimens there is a short lunula, which is narrow or very narrow.

Epidermis smooth, but with numerous irregular concentric wrinkles, which are always crossed by more or less distinct radially impressed lines, forming here and there low ridges. Where the beak-sculpture is well preserved, it is seen that this radial sculpture is not a direct continuation of the beak-sculpture, but is independent of it, beginning before the latter ends. In fact, the beginning of this sculpture causes, in part, the irregularities of the beak-sculpture. Color of epidermis yellowish brown to dark brown, generally darker posteriorly, without any distinct color markings. Sometimes there are greenish olive tints towards the beaks.

Hinge-line gently curved. Ligamental sinus shallow, over the middle of the lateral teeth. Lateral teeth strong, moderately long, one in right, two in left valve, descending posteriorly. In the youngest specimens, the upper margin is somewhat elevated above the posterior ends of the laterals, while in the others it is less elevated, almost parallel to them. Pseudocardinals strong, ragged, compressed, running obliquely forward and downward, straight or curved. In the right valve there are two pseudocardinals, the posterior higher and stronger, much cut up. In the left valve there is one strong tooth, much cut up, and sometimes a much smaller one behind it, which, however, may be absent. There is much variation in the raggedness of the pseudocardinals.

Cavity of beaks and shell rather shallow. Nacre whitish or lurid, iridescent. Anterior adductor-scar well impressed, subcircular, or subelliptical. Anterior retractor-scar small, rounded, above the adductor-scar and separated from it. Anterior protractor-scar rounded, connected with adductor-scar. Posterior ad-

ductor-scar faintly impressed, almost pear-shaped, subovate or subtriangular, with an upper triangular process formed by the posterior retractor-scar. Mantle-line distinct, remote from the margin about one-fourth to one-fifth (or less) of the height of the shell. Dorsal scars about five (more or less), in beak-cavity in an irregular, longitudinal row, sometimes shifted a little toward the narrow hinge-plate.

MEASUREMENTS.<sup>21</sup>

No.	Sex.	Length.	Height.	Diameter.	Beaks at	Greatest Height at	Fig.
			$\frac{\%}{100}$ L.	$\frac{\%}{100}$ L.	$\frac{\%}{100}$ L.	$\frac{\%}{100}$ L.	Pl.
Corumbá . . .		45 mm.	36 mm. = 80	20 mm. = 44	16 mm. = 36	23 mm. = 51	XXXIX
S. Isidro . . .	♀	76 "	66 " = 87	33 " = 43	20 " = 26	39 " = 51	f. 7.
Asunción . . .		85 "	69 " = 81	34 " = 40	25 " = 29	47 " = 55	Pl.
S. Isidro a. . .	♀	86.5 "	74.5 " = 86	36 " = 42	23 " = 27	45 " = 52	XXXIX
Do. b. . .	♀	90 "	77 " = 86	40.5 " = 45	25 " = 28	45 " = 50	f. 6.
Do. c. . .	♂	91 "	77 " = 85	42 " = 46	27 " = 30	47 " = 52	
Do. d. . .	♂	92 "	80 " = 87	39.5 " = 43	27 " = 29	55 " = 60	
Corumbá . . .		96 "	81 " = 84	41 " = 43	24 " = 25	50 " = 52	
Lea's figure . .		86 "	77 " = 90	33 " = 38	29 " = 34	46 " = 53	
Simpson . . .		92 "	78 " = 85	38 " = 41			
Do. . . . .		100 "	76 " = 76	47 " = 47			
D'Orbigny . .		101 "	86 " = 86	37 " = 37			

*Remarks.*—Lea has described two other large, subrotund species from the Uruguay River: *nocturnus* and *funeralis* (Obs. X, 1863, Pl. 42, fig. 288, and Pl. 41, fig. 286). Of these, *funeralis* is similar in general shape and proportions, with the exception of the much greater compression of the valves. The diameter is only 30 pr. ct. according to the figure and the measurements given by Simpson (1914 p. 1284), which falls far below of any of the measurements known for *paranensis*. In addition, in *funeralis*, the mantle-line is unusually far remote from the margin of the shell, and, according to our present knowledge, we must consider these characters as sufficient to separate the two species.

*U. nocturnus* was united with *paranensis* by Simpson in 1900, but in 1914 he separated them again. The proportions of *nocturnus* are:

	Length.	Height.	Diameter.	Beaks.	Greatest Height.
Lea's figure . .	72 mm.	60 mm. = 83 pr. ct. of L.	30 mm. = 41 pr. ct. of L.	at 21 mm. = 29 pr. ct. of L.	at 37 mm. = 51 pr. ct. of L.
Simpson's measur. .	72 "	60 " = 83 "	28 " = 39 "		

Thus there is no essential difference from *paranensis*, and according to Simpson's account, I can find only a difference in the color of the epidermis, which is

<sup>21</sup> More care must be taken in this species than in others to place the ligament horizontally, and to measure parallel and vertical to it. The greatest height of the shell is hard to locate, and allowance should be made for this.

said to be bottle-green, almost black posteriorly, in *nocturnus*. I do not think that this is sufficient to separate *nocturnus* from *paranensis*, since in the latter olive-green tints may also be noticed. This is seen chiefly in a specimen from the Hartman collection, without locality, preserved in the Carnegie Museum. Moreover, the original description of Lea's *paranensis* mentions this color.

The variability of the beak-sculpture of this species is remarkable. It has never been described in detail, except that it consists of rather heavy radial bars. In most of my specimens these bars are rather short (hardly more than 15 mm. long), but in three (all isolated valves, two from Asunción, one young from Corumbá) it extends farther, 25 to 27 mm., and chiefly in the young one (Pl. XXXIX, f. 7) this is very striking, since in this case the beak-sculpture extends over nearly half of the shell. I see, however, no other difference in these specimens, and even among them the bars are not uniform in length. I believe that *U. paraguayanus* Von Martens is founded upon such specimens. The dimensions of this fall easily within the range of variation of *paranensis*. According to Von Martens they are: length 102 mm.; height 82 mm. = 80 pr. ct. of length; diameter 47 mm. = 46 per. ct. of length. The location of the beaks is given as "three-fourths of the length," which probably corresponds to 25 pr. ct. of length, we measuring from the anterior extremity, the author having reversed the procedure.

Von Martens compares his species with *nocturnus*, but says that it is larger, with stronger sculpture (meaning apparently the beak-sculpture), and larger hinge-teeth, but all these characters are unreliable, and do not distinguish it from *paranensis*.

*Anatomy*.—The soft parts of two males and three barren females from San Isidro are at hand.

Color whitish, distal part of foot gray.

Anal opening closed above; the closed part being two to three times as long as the open, which is slit-like, and shorter than the branchial opening. Anal and branchial separated by a solid mantle-connection. Branchial opening with small, but distinct, papillæ. Palpi subtriangular, lower margins curved, posterior margins connected for about one-third of their length.

Gills moderately wide, posteriorly of about the same width, but anteriorly the inner gill is much wider. The shape of the latter is subtrapezoidal, that of the outer gill subtriangular. Anterior end of outer gill near the highest point of the mantle-attachment-line, that of the inner gill immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac.

Structure of non-marsupial gills as usual, with few and scattered interlaminar

connections. *Marsupium* of the female located in the inner gill, but not occupying all of it, leaving about one-fourth or a little less free at the anterior and the posterior end. In younger specimens the marsupial part is smaller, but also has a median position. Interlaminar connections of the marsupium forming interrupted septa, without any distinct transverse or quineuneal arrangement.

#### FINAL REMARKS ON THE GENUS DIPLODON.

It is not claimed that the above arrangement of the species of *Diplodon* should be regarded as in any sense final. Even the two subgenera, *Diplodon* and *Cyclomya*, cannot be sharply separated: they are intimately connected with each other, and *Cyclomya* is allied with the *ellipticus*-group of *Diplodon* through species like *rotundus*, *fontainianus*, and *gratus*. The other groups cannot be very sharply defined according to shell-characters. It is to be hoped that the anatomy may furnish better criteria for the grouping of the species; but unfortunately not enough species are known from this point of view, and some of those known are not known fully enough. The characters of the glochidia need further special study. The following facts, however, may be emphasized:

1. In six species of the *chilensis*-group (*frenzeli*, *imitator*, *simillimus*, *vicarius*, *decipiens*, *paulista*), the marsupium has a distinct tendency to move forward in the inner gill, and in three of these (*simillimus*, *vicarius*, *paulista*), it is entirely anterior to the middle of the gill. In five of these species, the structure of the interlaminar connections is interrupted septiform, or partly reticulate, but in one species (*decipiens*) continuous septa are formed. The glochidia of all these species have hooks.

The tendency of the marsupium to move forward is found in addition only in two species of the *ellipticus*-group (*gratus* and *deceptus*).

2. In the *charruanus*-group (*charruanus*, *piceus*, *uruguayensis*, *hildæ*), the marsupium is rather large and lies in the middle of the gill; sometimes (*hildæ*) it is smaller; and in two cases (*charruanus* and *hildæ*) it has a tendency to move backward. In the *lacteolus*-group (two species, *burroughianus* and *moggymirim*), the marsupium is also located slightly more posteriorly. In most of these species, the interlaminar connections form interrupted septa, in part reticulated. But there is one exception, for *moggymirim* has continuous septa. This structure is thus only known in two species (*moggymirim* and *decipiens*) belonging to different groups.

3. In the *ellipticus*-group, the marsupium may be in the middle of the gill (*enno*), slightly posterior (*berthæ*), or slightly anterior (*gratus*, *deceptus*). Its

structure may be prevailinglly reticulate (*berthæ*, *enno*), or prevailinglly septiform (*gratus*, *deceptus*).

4. *D. parancensis* has the marsupium in the middle half of the gill, and interrupted septiform structure is present.

5. In eight species, hooks are known to be present on the glochidia. Of these six belong to the *chilensis*-group, one to the *charruanus*-group (*piceus*), one to the *lacteolus*-group (*mogymirim*). Glochidia without hooks (but possibly immature) were found in *charruanus* and *berthæ* (*charruanus*- and *ellipticus*-groups). Two species have margined glochidia, *hasemani* of the *hyleus*-group, and *hildæ* of the *charruanus*-group.

For the present, these facts do not furnish any clue as to the relationship of the species or groups, they even are rather confusing, partly upsetting the divisions arrived at by the study of the shell. But they should be carefully recorded, because additional material may throw more light on the problem.

#### Genus CASTALINA Von Ihering (1891).

Von Ihering, 1891, p. 478; 1893, p. 73; Simpson, 1900, p. 865; 1914, p. 1204.

*Type-species*.—*C. martensi* Von Ihering (designated by Simpson).

The chief characters of this genus are found in the general shape of the shell, which is subtriangular or subquadrate, with a well developed posterior ridge and a subtruncated posterior slope, which, however, is somewhat elevated in the middle. In addition, the beaks are rather elevated, the interdentum is well developed, forming a rather deep beak-cavity. The hinge-teeth often are provided with parallel ridges.

The anatomy is similar to that of *Diplodon*. However, there is a tendency to close the branchial opening in front, yet this is not always the case, so that this character is variable, not only specifically, but also individually.

The genus has been well treated by Von Ihering (1893), and a key for the species has been given (p. 83). Simpson (1914 p. 1205) also gives a key, but *C. undosa* should be excluded; it is a *Castalia*.

#### 29. CASTALINA NEHRINGI Von Ihering (1893).<sup>22</sup>

*Diagram of soft parts*: text-fig. 2, p. 456; *Anatomy of gills*: Pl. XLVII, fig. 2; *Section of gills*: Plate XLVIII, fig. 5; *Glochidium*: text-fig. 41, p. 469.

*Type-locality*.—Rio Piracicaba, São Paulo, Brazil.

<sup>22</sup> Of both *C. nehringi* and *martensi* the specific names were first mentioned by Von Ihering in 1891 (p. 477), but as *nomina nuda* without descriptions.

*Material Represented in the Carnegie Museum.*—Rio Piracicaba, São Paulo, Brazil (Von Ihering, donor, cotypes or topotypes). Two specimens. Rio Tieté, Salto das Cruzes, São Paulo, Brazil (J. D. Haseman coll., September 22, 1908). Four specimens, two of them with soft parts. Rio Tieté, 25 miles above Itapura, São Paulo, Brazil (J. D. Haseman coll., September 27, 1908). Eight specimens, six of them with soft parts.

*Distribution.*—Rio Tieté and Rio Piracicaba in São Paulo, headwaters of Rio Paraná.

Von Ihering has given a detailed description of this species, pointing out its differences from the allied species. He believes that specimens with the beaks more distant from the anterior margin are males. I cannot control this, since I have no males among those of my specimens with soft parts, but the percentage given for the location of the beaks in the males (28 to 30 pr. et.) is not represented in my measurements, and this would tend to confirm Von Ihering's observation. It is to be noted that my smallest specimens (Nos. 1 to 5 from Itapura) exceed in height the figures given by Von Ihering, and thus young shells are proportionally higher: the older ones become longer on account of a prolongation of the posterior end of the shell (best seen in No. 6 from Itapura).

## MEASUREMENTS.

	No.	Sex.	Length.		Height.		Diameter.		Beaks.	
Itapura.....	1	♀	51	mm.	46	mm. = 90 pr. et. of L.	26	mm. = 51 pr. et. of L.	at 9	mm. = 18 pr. et. of L.
Do. ....	5	♀	54	"	46.5	" = 86 "	29.5	" = 55 "	11	" = 20 "
Do. ....	3	♀	55	"	48	" = 87 "	26	" = 47 "	10.5	" = 19 "
Salto das Cruzes.....	1	♀	61.5	"	49.5	" = 80 "	31	" = 50 "	12	" = 20 "
Do. ....	2	♀	69	"	55.5	" = 80 "	34	" = 49 "	15	" = 22 "
Itapura.....	6	♀	81	"	64	" = 79 "	40	" = 49 "	15.5	" = 19 "

*Anatomy.*—I have the soft parts of eight specimens, all of which are females, three of them gravid. One of the latter had eggs; one had immature, and the third mature glochidia. For the breeding season the dates of collection (September 22 and 27) should be noted. (Mature glochidia were found on Sept. 22.)

Von Ihering (1893, p. 79) describes the soft parts of two males. Of these, one had the branchial opening closed in front, the other open. This is the species of *Castalina*, to which I have referred previously (Ortmann, 1911, p. 118). In none of my females is there an anterior mantle-connection in front of the branchial opening. Therefore this seems to be the normal condition in this species, although it should be born in mind that this connection at its best is very slight, and might be easily torn by rough handling.

The anal opening is described by Von Ihering as also differing in his two

specimens. He mentions the presence in one of a supra-anal opening; but is not quite positive that this is natural. According to my material, the anal is always closed above, without forming a supra-anal (text-fig. 2, *s*, p. 456). The soft parts have the following characters:

Anal opening closed above; open part (text-fig. 2, *a* p. 456) short, somewhat shorter than the branchial, slit-like, its inner margin indistinctly crenulated or smooth. Closed part (*s*) about three to four times as long as the open part. A supra-anal canal extends all the way under the closed part (above the rectum), ending blindly above. Mantle-connection between anal and branchial openings well developed (text-fig. 2, *t*). Branchial opening (*b*) with well developed papillæ on inner margin, which show some irregularities at the anterior end of the opening, but in none of my specimens are distinct traces of a connection of the mantle margins in this region visible. Palpi (*h*) large, subtriangular, almost falciform, with long and curved lower margins, and short posterior margins, the latter connected for about one half of their length.

Gills (text-fig. 2, *i*, *o*) moderately wide, the inner (*i*) distinctly wider, chiefly anteriorly. Outer gill (*o*) with gently curved edge, its anterior end near the highest point of the mantle-attachment-line. Inner gill with the edge almost straight, anteriorly a little narrower, and broadly attached, the attachment occupying all of the space between the anterior end of the outer gill and the palpi (*h*). Inner lamina of inner gill entirely connected with abdominal sac. In the female (Pl. XLVII, fig. 2) the inner gill is *marsupial*, but only a section of the gill possesses this character, with the interlaminar connections distinctly arranged in interrupted septa (See also Pl. XLVIII, fig. 5). The marsupial part is rather small in younger specimens (such as the one figured on Pl. XLVII, fig. 2), lying immediately behind the middle of the gill; but it is larger in older specimens, lying practically in the middle, leaving free about one-third anteriorly as well as posteriorly (text-fig. 2, *i*). The non-marsupial gills have remote, incomplete, interrupted septa, and the septiform structure is more evident than it generally is in *Diplodon* (See outer gill, Pl. XLVII, fig. 2).

When charged, the eggs or glochidia do not form placenta-like masses. The fully developed *glochidium* (text-fig. 4, *l*, p. 469) is subtriangular, with a lower point situated about in the middle of the lower margin, and with distinct hooks at this point, which differ from those seen in certain species of *Diplodon* in that they are shorter, and broader at the base. L. 0.26 mm.; H. 0.24 mm.; hooks: 0.06 mm. Thus the glochidium is rather small.



30. *CASTALINA MARTENSI* Von Ihering (1893).

Von Ihering, 1893, p. 81, Pl. 3, fig. 5; Simpson, 1900, p. 865; 1914, p. 1205.

*Type-locality*.—Rio Camaquã, Rio Grande do Sul, Brazil.

*New locality*.—Rio Jacuhy, Cachocira, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 27, 1909). Three complete shells and one right valve.

*Distribution*.—Our new locality extends the range of this species northward. The Rio Jacuhy belongs to the Guaíba-system, but both the Guaíba and Camaquã flow into the Lagoa dos Patos. Von Ihering says that he did not find this species north of the Rio Camaquã.

This species has been sufficiently well described by Von Ihering. Our youngest specimen shows well developed beak-sculpture, corresponding to the description. The variations mentioned by Von Ihering in the crenulation of the lateral teeth are also seen in our specimens.

## MEASUREMENTS.

Length.	Height.	Diameter.	Beaks.
26 mm.	21.5 mm. = 83 pr. et. of L.	13.5 mm. = 52 pr. et. of L.	at 8.5 mm. = 33 pr. et. of L.
48 "	38 " = 79 "	24 " = 50 "	12 " = 25 "
48 "	40.5 " = 84 "	26 " = 54 "	13 " = 27 "
75 "	55 " = 73 "	34 " = 45 "	21 " = 29 " Largest specimen of Von Ihering)

The height ranges according to Von Ihering from 70 to 79 pr. et., and the diameter from 45 to 50 pr. et. The location of the beaks is from 21 to 29 pr. et. Thus our specimens are comparatively higher and more swollen. As far as concerns the height, this is certainly due to the smaller size of my shells, since a similar change in the proportional height with age has been observed in *C. nehringi*.

*Anatomy*.—Of this species Von Ihering (1891, p. 477) says that in most cases (seven out of eight) the branchial opening is closed in front. I do not possess the soft parts.

31. *CASTALINA PSAMMOICA* (D'Orbigny) (1835).

*Unio psammoica* D'ORBIGNY, 1843, p. 608, Pl. 71, figs. 4-7; SOWERBY, XVI, 1868, Pl. 93, fig. 507.

*Castalina psammoica* VON IHERING, 1893, p. 79; VON MARTENS, 1894, p. 164; SIMPSON, 1900, p. 866; 1914, p. 1206; Haas, 1916, pp. 9, 47.

*Type-locality*.—Rio Paraná, Itaty, above Corrientes, Argentina.

*Other Localities*.—Province Santa Fé, Argentina (D'Orbigny) (farther down the Paraná); Rio Paraguay, near mouth of Rio Apa (Von Ihering) (in Paraguay, at Brazilian boundary); Paraguay (Von Martens); Rio Uruguay, Salto Oriental, Uruguay (Haas).

*New Localities.*—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 5, 1909). One young male with soft parts. Rio de la Plata, San Isidro, 20 km. north of Buenos Aires, Argentina (A. Windhausen coll., January 1917). One male with soft parts.

*Distribution.*—From the La Plata near Buenos Aires up to the Rio Paraná and Rio Paraguay in Paraguay, and also in the Rio Uruguay.

The descriptions given by D'Orbigny, Von Ihering, and Simpson agree well with our specimens, but it should be mentioned that the beak-sculpture sometimes covers less than half of the adult shell. The hinge-teeth are very variable, but Von Ihering's account represents the normal condition. The laterals are said to be smooth or finely smoothly striated. In my young specimen they have distinct, vertical, irregular, and granular ridges; in my larger specimen they are irregularly granular and crenulated, but have no distinct vertical ridges.

According to Von Ihering, the maximum length is 70 mm.; according to D'Orbigny, 75 mm. The height according to the former is 77 to 80 pr. et.; according to the latter, 76 pr. et.; the diameter is 50 and 49 pr. et. respectively. The beaks are located, according to Von Ihering at 17 to 23 pr. et. of the length.

MEASUREMENTS.

Localities.	Sex.	Length.	Height.	Diameter.	Beaks.
Uruguayana.....	♂	44 mm.	35 mm. = 80 pr. et. of L.	23 mm. = 52 pr. et. of L.	at 10.5 mm. = 24 pr. et. of L.
San Isidro.....	♂	62 "	50 " = 81 "	37.5 " = 60 "	14 " = 23 "

Thus our larger specimen is unusually swollen.

*Remarks.*—This species somewhat resembles the genus *Castalia*, chiefly on account of the strong development of the beak-sculpture. However, according to the posterior slope, which is distinctly elevated along the upper posterior margin, and also according to the structure of the lateral teeth, which have the vertical ridges poorly, or not at all, developed, it is a *Castalina*. In *Castalia* furthermore the diameter of the shell generally is much greater than the maximum (60 pr. et.) observed in the present species.

*Anatomy.*—Soft parts of two males at hand. Color whitish.

Anal opening slit-like, closed above; closed part three to four times as long as the open, the latter shorter than the branchial opening, and separated from it by a solid mantle-connection. Branchial with small papillæ. In the smaller specimen, the branchial opening is closed in front by a firm union of the mantle-margins, but in the larger specimen there is no such connection, and thus in this species this character is variable. Palpi rather large, nearly subfalciform, with the lower

margins long and strongly curved, posterior margins short, and united at base for about one-fourth of their length.

Inner gills much wider than the outer, chiefly in front; only for a short distance behind have they an equal width. Outer gill with curved margin, anterior end at highest point of mantle-attachment-line. Inner gill with margin nearly straight, broadly attached anteriorly, and anterior end close to the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Structure of non-marsupial gills normal, with scattered interlaminar connections, assuming here and there the shape of short, weak septa.

#### Genus CASTALIA Lamarek (1819).

*Castalia* LAMARCK, 1819, p. 66; PILSBRY, 1911, p. 610.

*Tetraplodon* SPIX, 1827, Pl. 25; PILSBRY, 1893, p. 90; SIMPSON, 1900, p. 863; 1914, p. 1194.

Pilsbry (1911) has brought to light the fact that Savigny's genus *Castalia* (*Vermes*) is not to be dated from 1817, but that it is later (certainly not before 1820, probably as late as 1826), so that *Castalia* applied by Lamarek (1819) to the present genus has to stand.

*Castalia* is distinguished by the triangular outline, with high beaks, well developed posterior ridge, great obesity of the shell, truncated posterior slope, and well developed beak-sculpture, which extends over a large part of the shell. It is to be noted, however, that the truncation of the posterior slope often varies with age, so that in very young specimens it is somewhat elevated in the middle, giving an outline to the shell approaching the subtrapezoidal or subrhomboidal. With one exception the species resemble each other very closely. This exception is *C. undosa*, which differs from all the rest in having strong, oblique folds, or ribs, upon the posterior slope.

My material of *Castalia* is rather insufficient, and I have had great difficulties in determining the species. The key given by Simpson (1914) is useless for the reason that the type-species (*ambigua*) has been misunderstood. The latter has been redescribed and figured by Von Ihering (1910),<sup>23</sup> which fact had been neglected by Simpson. At the same time Von Ihering has given an elaborate key for the species. However, this also is unsatisfactory, and I am afraid that Von Ihering has not paid proper attention to the changes undergone by the shell with advancing

<sup>23</sup> In this connection it should be mentioned that Wyatt, T. (*A Manual of Conchology*, 1838, p. 65, Pl. 11, fig. 5) has given a recognizable figure of *C. ambigua*, which undoubtedly represents the genuine *ambigua*, as determined by Von Ihering).

age. In trying to use this key, I generally met with the difficulty that my specimens were intermediate between the alternatives given in it. But, as I said, my material is too scanty to bring order out of this confusion, yet I shall try my best to give an account of the material at hand.

The geographical distribution of the species of this genus is interesting. According to Von Ihering (1910, p. 130) their metropolis is in the Amazon-drainage, whence the forms extend into Guyana and the upper Paraná-drainage. But on account of the great uncertainty prevailing with regard to the various species no details can be given.

32. *CASTALIA ACUTICOSTA* Hupé (1857).

*Glochidium*: Text-fig. 4, *m*, p. 469.

*Castalia acuticosta* HUPÉ, 1857, p. 77, Pl. 14, fig. 3; SOWERBY, XVII. 1869, Pl. 3, fig. 12.

*Tetraplodon acuticosta* VON IHERING, 1910, p. 128.

*Type-locality*.—Brazil. (Von Ihering says that Castelnau collected this species in Goyaz, but I cannot find this fact mentioned in Hupé's paper.)

*Other Localities*.—Rio Araguay, Goyaz, Brazil (Von Ihering, 1910, p. 135); Lagoa do Coral, Goyaz, Brazil (Von Ihering) (drainage of Rio Araguay, tributary to Tocantins).

*New Localities*.—Sand-bar of Rio Tapajos, Santarem, Pará, Brazil (J. D. Haseman coll., December 6–12, 1909). Eight specimens, one of them a male with soft parts. Center of Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil (J. D. Haseman coll., July 20, 1909). Three specimens, with soft parts, male, and gravid females. Rio Guaporé, São Antonio de Guaporé, Matto Grosso, Brazil (J. D. Haseman coll., July 31, 1909). Four specimens. Rio Machupo, San Joaquim, Bolivia (J. D. Haseman coll., September 1, 1909). Three young specimens, with soft parts, probably males.

In addition, the Carnegie Museum possesses a fine specimen from the Juny collection, without locality.

*Distribution*.—Southern tributaries of the Amazon, from Tocantins and Araguay in Goyaz, and Rio Tapajos in Pará, to the Madeira (Guaporé and Machupo) in Matto Grosso and Bolivia.

This species belongs to those with elevated beaks, although the beaks are here far less prominent than in *turgida*, *baro*, and *hanleyana*. It is a small species (maximum length 35 mm.); but that specimens about 25 mm. long are mature is shown by the fact that at that size they may be gravid.

The outline is "subquadrate" according to Von Ihering. I should call it rather subtrapezoidal or subrhomboidal, and this is due to the fact that the posterior end is not much produced, and that the angle between the upper and the posterior margins is somewhat prominent; consequently, the posterior slope is not so much truncated as in other species, but a little elevated toward the upper posterior angle. On account of the shortness of the shell, the beaks are comparatively remote from the anterior end.

Von Ihering has pointed out that there are variations in the beak-sculpture, and I observe this also in my specimens. In most cases it is sharp, the bars are narrow and distinct, and extend to the lower margin of the shell. But sometimes the bars are more rounded, less distinct, and may not reach the lower margin. A few finer radial bars are generally present upon the posterior slope.

## MEASUREMENTS.

Localities.	No.	Sex.	Length.	Height.	Diameter.	Beaks.
Santarem.....	2	?	18.5 mm.	16 mm. = 86 pr. ct. of L.	14 mm. = 76 pr. ct. of L.	at 5.5 mm. = 24 pr. ct. of L.
Do. ....	3	♂	20 "	18 " = 90 "	17 " = 85 "	6.5 " = 33 "
Guaporé.....	2	♀	24 "	20 " = 83 "	19 " = 79 "	6.5 " = 27 "
Do. ....	1	♀	24 "	20.5 " = 85 "	18 " = 75 "	6 " = 25 "
Do. ....	3	♂	28 "	24.5 " = 88 "	21 " = 75 "	8 " = 29 "
Santarem.....	6	?	29 "	25 " = 86 "	22 " = 76 "	8.5 " = 29 "
?	3	?	30 "	27 " = 90 "	23 " = 77 "	10 " = 33 "
Hupé, text-figure.....	34	"	26 "	" = 76 "	23 " = 68 "	"

It should be remarked that Hupé's figure of the diameter (half shell) does not agree with his measurements in the text. This figure would give a diameter of only 18 mm. (= 53 pr. ct.,) while the text gives 68 pr. ct. Both height and diameter of Hupé's shell are less than in any of mine. Von Ihering gives the location of the beaks at 39 to 41 pr. ct. of the length, which is much greater than the figures of Hupé (31 pr. ct. according to the figure) and of my shells. But I believe that this discrepancy is due to a different way of measuring; I always measure parallel to the ligament.

*Remarks.*—My specimens certainly belong together; but I am not quite positive that they might not be only the young stage of some other species (*hanleyana* or *baro*). The fact that some of mine are gravid does not demonstrate that they are adult or nearly adult, for we know that other *Naiades* become sexually mature, when yet rather small. The further fact that those from Santarem were found associated with *baro* and *hanleyana* indicates that they may belong to these species. However, I am unable to decide this question.

*Anatomy.*—Soft parts of two males and two gravid females (with glochidia) at hand. The latter were found on July 20. Color of soft parts whitish.

Anal opening slit-like, closed above; closed part about four to five times as long as the open, the latter separated from the branchial opening by a solid mantle-connection. Branchial opening with small papillæ, closed in front by a mantle-connection in the two males and in one of the females, while in the other female this connection is missing (but it may be torn). Palpi moderately large, subtriangular, with curved lower margins, and the posterior margins united for about one-fourth of their length.

Gills about equally wide posteriorly, anteriorly the inner is the wider, of the usual shape. Inner lamina of inner gill entirely connected with the abdominal sac. Non-marsupial gills with scattered interlaminar connections. *Marsupium* in the middle of the inner gill, leaving about one-fourth of the gill free at the anterior end, and a little less at the posterior. Interlaminar connections interrupted, but their arrangement cannot be clearly seen, since no barren females are at hand.

Glochidium (text-fig. 4, *m*, p. 469) subtriangular, with a point at about the middle of the lower margin, and with hooks of the usual shape, but rather short. L. and H. about 0.24 mm., hooks 0.05 mm. Thus the glochidium is rather small.

### 33. *CASTALIA HANLEYANA* Sowerby (1869).

*Castalia hanleyana* SOWERBY, XVII, 1869, Pl. 1, f. 5.

*Tetraplodon hanleyanus* VON IHERING, 1910, p. 127.

*Type-locality*.—Unknown.

*Other Localities*.—Rio Araguaya, Ilha Bananal, Goyaz, Brazil (Von Ihering); State of Pará, Brazil (Von Ihering).

*New Locality*.—Sand bar of Rio Tapajos, Santarem, Pará, Brazil (J. D. Hase-man coll., December 6-12, 1909). Two odd valves (right and left).

*Distribution*.—It should be noted that this species is found, where also *acuticosta* occurs, in the Rio Araguaya and the Rio Tapajos.

My two valves agree well with the account given by Von Ihering, and with Sowerby's figure, but are smaller than the latter.

#### MEASUREMENTS.

Length.	Height.	Diameter.	Beaks.
42.5 mm.	35 mm. = 82 pr. ct. of L.	28 mm. = 66 pr. ct. of L.	at 12 mm. = 28 pr. ct. of L.
36.5 "	31 " = 85 " "	27 " = 74 " "	10.5 " = 29 " "

*Remarks*.—According to Von Ihering, the beaks are at 30 to 33 pr. ct., while my specimens show lower figures. But this fact may be due to a different way of measuring. The shell is characterized by high beaks and its high, triangular (not

elongated) shape, which makes the beaks appear to be rather far back (in comparison with *baro*). However, this may be only a more aged form of *acuticosta*.

#### 34. *CASTALIA BARO* (Von Ihering) (1910)

*Castalia ambigua* SOWERBY (not LAMARCK), XVII, 1869, Pl. 1, fig. 1.

*Tetraplodon baro* VON IHERING, 1910, p. 127; SIMPSON, 1914, p. 1198.

*Type-locality*.—Amazon River.

*New Locality*: Sand bar of Rio Tapajos, Santarem, Pará, Brazil (J. D. Haseman coll., December 6–12, 1909). One complete shell, two odd valves, right and left.

In addition the Carnegie Museum has two other fine specimens, one from the Holland collection, labeled "River Amazon," the other from the Juny collection, without locality.

*Distribution*: Amazon and Tapajos Rivers.

This species stands very close to *C. hanleyana*, and differs only in its more elongated shape, and, consequently, more anterior beaks. Von Ihering says that the lower margin is straight (while it is convex in *hanleyana*). But this feature is somewhat variable, for it may be gently curved. However it is correct that in *baro* the lower margin is more nearly straight than in *hanleyana*.

I should not be astonished if *hanleyana* and *baro* should finally prove to be only the adult stages of *acuticosta*. The fact that all three have been found by Haseman associated at Santarem is in favor of this view.

About the dimensions of *baro* we only know that the beaks are at 16 pr. ct. of the length. My specimens show a somewhat higher percentage, but not as high as in *hanleyana* (where it is from 28 to 33 pr. ct.).

MEASUREMENTS.

Localities.	Length.	Height.	Diameter.	Beaks.
Santarem...	39 mm.	28 mm. = 73 pr. ct. of L.	27 mm. = 69 pr. ct. of L.	at 9 mm. = 23 pr. ct. of L.
Do. . .	45.5 "	33 " = 73 "	30.5 " = 67 "	9 " = 20 "
Amazon. . .	48 "	35 " = 73 "	32 " = 67 "	10.5 " = 22 "
(Juny) . . .	52.5 "	39.5 " = 75 "	37 " = 72 "	10 " = 19 "
Santarem..	55 "	40 " = 73 "	36 " = 65 "	10 " = 18 "

#### 35. *CASTALIA PECTINATA* (Spix) (1827).

*Tetraplodon pectinatum* SPIX, 1827, Pl. 25, fig. 3; VON IHERING, 1910, p. 125.

*Unio pectinatus* WAGNER, 1827, p. 32.

*Castalia ambigua* VON IHERING (not LAMARCK), 1890, p. 162.

*Type-locality*.—Rio São Francisco, Minas Geraes, Brazil.

*New Localities.*—Amazon River, Pará, Brazil (Hartman collection). Two specimens. Sand bar of Rio Tapajos, Santarem, Pará, Brazil (J. D. Haseman coll., December 6–12, 1909). One odd (right) valve.

*Distribution.*—Known hitherto only from the Rio São Francisco, and only from the description and figure of Spix and Wagner. Its discovery in the Amazon and Tapajos in Pará thus extends its range into the lower basin of the Amazon.

The characters of this species have been established by Von Ihering, and, although it is hazardous to define an old, often misunderstood, and poorly figured form, without having abundant material, the fact that our specimens well agree with the account given by Von Ihering, demonstrates that he is right. The chief characters of this species are found in the low beaks, the rather elongated outline, and rather anterior position of the beaks. The beak-sculpture is described as “mostly” reaching the ventral margin. This is actually the case in one of our specimens from the Amazon and in the half shell from the Tapajos. In the other individual from the Amazon the radial bars are shorter and cover only a little more than half of the shell.

## MEASUREMENTS.

Locality.	Length.	Height.	Diameter.	Beaks.
Amazon. . .	28 mm.	21.5 mm. = 77 pr. ct. of L.	17 mm. = 61 pr. ct. of L.	at 6 mm. = 21 pr. ct. of L.
Tapajos. . .	28 “	21 “ = 75 “	18 “ = 64 “	6.5 “ = 23 “
Amazon. . .	31 “	23 “ = 74 “	20 “ = 65 “	8 “ = 26 “

*Remarks.*—Von Ihering gives the location of the beaks as 25 pr. ct.; my specimens agree with this very well.

*C. juruana* (Von Ihering, 1910, p. 126) from the Rio Juruá (southern tributary of the Amazon in western Brazil) is closely allied. It is founded upon a single specimen, which differs chiefly in the location of the beaks (at 37 pr. ct.), and certain other characters, which at least in part are connected with this. It may finally prove to be only a form of *pectinata*.

Our specimens have about the size given by Wagner in the text (*l. c.*, p. 33) 28 to 31 mm.; while Spix's figures (Pl. 24, figs. 3, 4) are considerably larger (L. over 40 mm.). Thus they apparently are enlarged. *C. juruana* is larger, L. 46 mm.

36. *CASTALIA INFLATA* D'Orbigny. (1835).

*Castalia inflata* D'ORBIGNY, 1835, p. 43.

*Castalia ambigua* D'ORBIGNY, 1843, p. 598, Pl. 72, figs. 4–6.

*Castalia ambigua inflata* VON IHERING, 1893, p. 88.

*Castalia quadrilatera* VON IHERING, 1893, p. 89.



*Tetraplodon inflatus* VON IHERING, 1910, p. 126; 1915, p. 12.

*Type-locality*.—Paraná River, Corrientes, Argentina.

*Other Localities*.—Lower Paraná River (Von Ihering); small tributaries of the Paraná (D'Orbigny); Rio Paraguay, near Rio Apa, Paraguay (Von Ihering); Rio Paraguay, San Luis de Caceres, Matto Grosso, Brazil (Von Ihering).

*Locality Represented in Carnegie Museum*.—Rio Paraguay, San Luis de Caceres, Matto Grosso, Brazil (J. D. Haseman coll., May 24, 1909). Two specimens.

*Distribution*.—Positively known only from the Paraná and Paraguay Rivers in Argentina, Paraguay, and Brazil. Specimens reported from the Amazon-drainage in Bolivia probably do not belong here.

My identification of this species depends partly on Von Ihering's key, partly on D'Orbigny's original description and figures of specimens from Corrientes, and on the locality. It is a species with low beaks, the shell is oval, but for the rest, Von Ihering's key is insufficient. One of my specimens is rather small, and the beak-sculpture reaches the lower margin; in the other, it falls short of it. The beaks are located at 21 and 24 pr. ct. (21 pr. ct. given by Von Ihering). The shell is about as long as in *pectinata*, and is thicker. The bars of the beak-sculpture in my specimen are rather numerous, but not very sharp. The adductor-sears agree with Von Ihering's account. Thus I have no doubt that my specimen represents *C. inflata*, although the essential characters of this species are yet obscure.

MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
	29 mm.	23 mm. = 79 pr. ct. of L.	20 mm. = 69 pr. ct. of L.	at 6 mm. = 21 pr. ct. of L.
D'Orbigny's text .....	36 "	26 " = 72 "	22.5 " = 63 "	8.5 " = 24 "
D'Orbigny's fig. of specimen from Corrientes .....	65 "	75 "	60 "	
	35 "	25.5 " = 73 "	24 " = 70 "	8.5 " = 24 "

Von Ihering does not give detailed measurements, but only says that the maximum length is 51 (1893) and 60 mm. (1910).

### 37. *CASTALIA UNDOSA* Von Martens (1885).

*Shell*: Plate XXXIX, figs. Sa-d.

*Castalia undosa* VON MARTENS, 1885, p. 148; VON IHERING, 1893, p. 84; NEHRING, 1893, p. 165.

*Castalina undosa* SIMPSON, 1900, p. 866; 1914, p. 1207.

*Tetraplodon undosus* ORTMANN, 1911a, p. 117, Pl. 6, fig. 7, Pl. 7, fig. 7 (anatomy).

*Type-locality*.—Rio Piracicaba, Piracicaba, São Paulo, Brazil.

*Localities Represented in Carnegie Museum.*—Rio Piracicaba, São Paulo, Brazil (Von Ihering donor, authentic specimens). One complete shell and one odd (left) valve. Rio Tieté, silty river banks, twenty-five miles above Itapura, São Paulo, Brazil (J. D. Haseman coll., September 27, 1908). Four specimens with soft parts, one male and three females. Rio Tieté, Itapura, São Paulo, Brazil (J. D. Haseman coll., September 28, 1908). Five specimens, one of them a male with soft parts.

*Distribution.*—Rio Tieté and Piracicaba of Upper Paraná-drainage in São Paulo, Brazil.

This species has been well described by Von Martens and Von Ihering, and I do not need to add anything, except that the dimensions vary considerably, the height from 71 to 86 pr. et. and the diameter from 53 to 66 pr. et. of the length. On the average our specimens are more swollen than the previous measurements would indicate. The most characteristic feature of this species is the quite unique development of the ribs of the posterior slope, which are much stronger than the oblique "wrinkles" often found in species of *Diplodon*.

Simpson has put this species in the genus *Castalina*, but I do not see any reason for this. The posterior slope undoubtedly has the characters of *Castalia*. The species, indeed, stands isolated in the genus, and cannot be confounded with the other species, and for this reason, probably, Von Ihering omitted it in his key (1910).

## MEASUREMENTS.

No.	Sex	Length.		Height.		Diameter.		Beaks.		Figure.
	?	42	mm.	34	mm. = 81 pr. et. of L.	26	mm. = 62 pr. et. of L.	at 10	mm. = 24 pr. et. of L.	Pl. XXXIX,
x.....	♀	46.5	"	39	" = 84 "	27	" = 58 "	11.5	" = 25 "	fig. 8.
b.....	♀	47	"	37.5	" = 80 "	31	" = 66 "	11.5	" = 24 "	
c.....	♀	51	"	38.5	" = 75 "	31	" = 61 "	13	" = 25 "	
a.....	♂	57	"	44	" = 77 "	33.5	" = 59 "	13.5	" = 24 "	
	♂	60	"	47	" = 78 "	36	" = 60 "	14	" = 23 "	
(Von Martens) ..		56	"	48	" = 86 "	30	" = 53 "	2/7	= 29 "	
(Von Ihering)		66	"	50	" = 76 "	36	" = 55 "			

*Anatomy.*—The soft parts of two males and three barren females are at hand.

A description has been previously given by myself (1911a, p. 117). However, it should be added that in one female investigated the branchial opening is open in front, but probably torn. In another, a male, it is undoubtedly open; this is an old individual, the largest at hand, and here also it may be that it has been injured during life. In the other three specimens (one male and two females), the branchial opening is closed in front. According to Von Ihering (1891, p. 476), this opening is closed in 80 pr. et. of the cases.

Anal opening closed above; closed part three to four times as long as the open part, the latter slit-like, shorter than the branchial, and separated from the latter by a solid mantle-connection. Branchial opening with papillæ, closed in front by a firm union of the inner mantle-edges, or, more rarely, open and without this connection. Palpi rather large and slightly produced posteriorly, with strongly curved lower margins. Their posterior margins are connected for about one-third of their length.

Gills of the usual shape, the inner much wider in front than the outer, its anterior end close to the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Non-marsupial gills with scattered interlaminar connections. *Marsupium* of the female located in the inner gill, but it does not occupy all of this gill, but only a portion in the middle, leaving free a larger part anteriorly, and a smaller posteriorly, so that the marsupium appears shifted slightly backwards. Interlaminar connections of marsupium arranged in interrupted septa.

#### Genus HYRIA Lamarek (1819).

*Hyria* LAMARCK, 1819, p. 81; SIMPSON, 1900, p. 868; 1914, p. 1211.

This genus is characterized by the alate shape of the shell, possessing wings both at the anterior and posterior end of the upper margin. In addition the radial beak-sculpture is well developed, covering a considerable part of the shell, the posterior ridge is rounded and broad, and the pseudocardinals are much compressed. The hinge-teeth may be somewhat corrugated, but they do not possess distinct vertical ridges.

The distribution of this genus is restricted to the basin of the Amazon and the rivers of Guyana. A key to the species has been furnished by Simpson (1914, p. 1212), but some of the species may be only forms of others.

#### 38. *HYRIA CORRUGATA* Lamarek (1819).

*Hyria corrugata* LAMARCK and *H. transversa* HUPÉ, SIMPSON, 1900, pp. 868, 869; 1914, p. 1212, 1215.

*Type-locality*.—Unknown.

*Other Localities*.—Rio Solimoes (= middle Amazon) (*Triplodon rugosum* Spix, Wagner, 1827, p. 35); Rio Yavari, Brazil (southern tributary of Amazon, forming a boundary between Brazil and Peru) (Haas, 1916, p. 9, 47).

*New Locality*.—Sand-bar of Rio Tapajos, Santarem, Pará, Brazil (J. D. Hase-man coll., December 6–12, 1909). About fifty specimens, among them two females with soft parts.

Several other specimens are preserved in the Carnegie Museum, from the Hartman, Smith, and Juny collections, but all are labelled "Amazon River."

*Distribution*.—According to Simpson Eastern Peru to Guiana; south throughout Brazil. However, the few special localities known are all on the Amazon and its tributaries.

It should be remarked in the first place that all my specimens undoubtedly represent but one species, showing a great deal of variation, the various forms all connected by intergrades.

Simpson describes this species as having a "subrhomboidal" shape and with the beak-sculpture covering only part of the surface. He retains *H. transversa* Hupé (from Brazil) as a distinct species, which has "rhomboidal" shape, and only a "few strong umbonal ridges." Specimens from the Rio Tapajos at hand represent both forms, and pass gradually into each other, so that I am forced to regard *H. transversa* as only an individual variation of *H. corrugata*.

The extreme development of the beak-sculpture, covering the whole shell, is found in *H. rugosissima* Sowerby. Some of my specimens approach this condition, but none fully agree with Sowerby's figure (XVII, *Hyria*, 1869, Pl. 3, fig. 5), so that this form is not represented in my material, and I cannot say whether it is a good species or not.

Sowerby (*l. c.*, Pl. 2, fig. 3) distinguishes *H. exasperata* (British Guyana) from *H. corrugata* (Pl. 1, fig. 1), the former being longer and more compressed, the latter shorter and more swollen. Simpson unites these two; but among my material I have no specimens which corresponds exactly to the *corrugata* of Sowerby. If the two should be different, my specimens would fall under *exasperata* Sowerby (1869) which undoubtedly is synonymous with *Triplodon rugosum* Spix (1829).

Frierson (1915, p. 363) has recently described *H. amazonia*. In outline this easily falls within the range of my specimens of *corrugata*, chiefly specimens with less developed beak-sculpture (*H. transversa* Hupé). But *H. amazonia* is decidedly more swollen. Being founded upon a single specimen, it is impossible to decide whether *amazonia* is a good species.

In shape my specimens vary greatly. They are all rather compressed, but there is some variation in this respect. The greatest irregularity, however, is seen in the outline and beak-sculpture. The wings of the shell are of various sizes, chiefly the posterior one, which may be rather short, or drawn out, broader or narrower, and may be more or less elevated. Sometimes the wings assume freakish shapes, curving up or down, or being deflected laterally. Thus the whole shell is more or less elongated, and more broadly or more narrowly triangular. The

beak-sculpture is generally well developed, and covers all of the shell in young specimens; but in older individuals it disappears near the lower margin, and sometimes it is poorly developed, and present only for a short distance from the beaks (form *transversa* Hupé), but, as stated above, the latter specimens are connected with the typical form by intergrades.

*Anatomy*.—Two females are at hand, one of them gravid, and with eggs (collected December 10).<sup>24</sup>

The soft parts have been previously described and figured by myself (1911a, pp. 108, 114, Pl. 6, fig. 6, Pl. 7, fig. 6).

Anal opening closed above; closed part about twice as long as the opening, the latter slit-like, separated from the branchial opening by a mantle-connection. Branchial opening with small papillæ, not closed in front. Palpi rather small, subtriangular, posterior margins not connected.

Gills of the usual shape, the inner much wider anteriorly than the outer, its anterior end close behind the palpi).<sup>25</sup> Inner lamina of inner gill entirely connected with abdominal sac. Non-marsupial gills with scattered interlaminar connections. *Marsupium* of the female in the inner gill, restricted to the middle portion, about one-fourth of the gill at anterior end, and a little less than that at the posterior end being non-marsupial. Interlaminar connections of marsupium crowded and numerous, forming interrupted septa, and assuming in the most central part an irregularly quincuncial (reticulate) arrangement.

#### Genus *PRISODON* Schumacher (1817).

Simpson, 1900, p. 869; 1914, p. 1216.

Closely allied to *Hyria* in the doubly alate shell, but differing in the absence of beak-sculpture, and the strong development of a sharp posterior ridge.

A key to the species has been given by Simpson (1914, p. 1217).

This genus is also characteristic of Guyana and the Amazon-drainage in Brazil.

#### 39. *PRISODON ALATUS* (Sowerby) (1869).

*Shells*: Plate XL, figs. 1, 2, 3.

*Hyria alata* SOWERBY, XVII, 1869, Pl. 5, fig. 13.

*Prisodon alatus* SIMPSON, 1900, p. 871; 1914, p. 1220.

*Type-locality*.—Guyana.

<sup>24</sup> The shell of this gravid female approaches the form *transversa*, with the beak-sculpture less developed, but with the shape not very elongated. The other female is a normal *corrugata*, half-grown.

<sup>25</sup> The connection of this gill with the palpi described previously is only accidental, and seen only on one side of the larger female; on the other side, and also in the smaller female, the structure is normal.

*New Locality*.—Sand-bar of Rio Tapajos, Santarem, Pará, Brazil (J. D. Hase-man coll., December 6–12, 1909). About sixty specimens, all dead shells.

*Distribution*.—The discovery of this species, hitherto apparently only known from Guyana, in the Amazon-drainage is interesting.

The shell is easily recognized by the relatively short triangular shape, and the excessive development of the anterior and posterior wings. The outline varies a good deal, being longer or shorter, and the lower posterior end of the shell may be blunt or somewhat pointed. The obesity is also variable. The wings are more or less developed, and the posterior one may be longer or shorter, sometimes as long as the rest of the shell, narrower or wider, pointed or blunt. It is directed straight backwards (forming a straight continuation of the hinge-line), chiefly so in young specimens; but in older ones it may be directed more or less upward, so that the hinge-line becomes concave. Upon the posterior slope there are sometimes a few (three to five) parallel folds or wrinkles, but most specimens lack these.

The pseudocardinals (Pl. XL, figs. 2*c*, *d*) of this species are very long and compressed, the posterior of the right valve is longer than the anterior, and extends far forwards, so as to be placed in its anterior part below the anterior. In the left valve there are also two pseudocardinals, the posterior shorter than the anterior, and extending only with its anterior end below the anterior. The upper and inner face of the posterior right pseudocardinal in its posterior part, and the space between the two teeth in the left valve, has distinct, parallel, and subvertical ridges. The lateral teeth (one in right, two in left valve) are only obliquely and granulately corrugated, but do not possess parallel vertical ridges. Thus in the structure of the pseudocardinals this species differs from other species of the genus (I have been able to compare *P. castelnaudi*, *obliquus*, *brownianus*), where these teeth are shorter, and the posterior one in each valve is split into several parts, without developing vertical ridges.

My specimens are of all sizes, but none of them reaches that of Sowerby's figure, which measures, from tip to tip of the wings, 115 mm., and from tip of anterior wing to lower posterior end of shell 115 mm.

MEASUREMENTS.

Length (Tips of Wings.)	Length (Anterior to lower posterior end.)	Height.	Diameter.	Figured.
78 mm.	65 mm.	40 mm.	25.5 mm.	Pl. XL, fig. 1.
94 "	69 "	43 "	29 "	
93 "	78 "	51 "	33 "	

For obvious reasons (odd shape of shell) measurements could not be made here in the usual way. It also should be noted that the wings of the largest specimens

are slightly broken off, and also in the two others they are not quite perfect. The length from tip to tip of the wings is most nearly parallel to the hinge-line. The height is measured vertically to the hinge-line, from the beaks to the lower margin.

40. *PRISODON CASTELNAUDI* (Hupé) (1857).

*Hyria castelnaudi* HUPÉ, 1857, p. 81, Pl. 16, fig. 1; SOWERBY, XVII, 1869, Pl. 4, fig. 8.

*Prisodon castelnaudi* SIMPSON, 1900, p. 871; 1914, p. 1220.

*Prisodon obliquus castelnaudi* VON IHERING, 1910, p. 135, 137.

*Type-locality*.—Brazil.

*Other Localities*.—Rio Araguaya, Goyaz, Brazil (Von Ihering); Rio Chingu, Pará, Brazil (Von Ihering).

*New Locality*.—Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil (J. D. Haseman coll., July 20, 1909). One young male with soft parts.

In addition, there is in the Carnegie Museum one larger specimen from the Hartman collection, labelled "River Amazon."

*Distribution*.—Positively known from the Amazon, two of the tributaries of its lower part in Goyaz and Pará, and from a tributary of the Madeira in Matto Grosso.

My specimens agree well with the account given by Simpson, but I should say that the hinge-teeth are not vertically ridged. The posterior pseudocardinal in either valve is cut up by deep fissures into accessory teeth, which are somewhat radiating. The lateral teeth are slightly rugose.

Von Ihering regards this as a variety of *P. obliquus* Schumacher (= *avicularis* Lamarek), and this is quite possible.

*Anatomy*.—A young specimen with soft parts is at hand, probably a male, since no marsupial structure can be seen.

Soft parts like those of *Hyria*. The palpi are slightly broader, and their lower margins more curved. The anterior end of the inner gill is immediately behind the palpi. Shape and structure of the gills normal.

Subfamily MUTELINÆ (See above, p. 457).

*General Remarks.*

Shells of various shapes, subelliptical, subovate, subtrapezoidal, or more or less rounded. Beak-sculpture absent, only in one case have subconcentric bars been observed, which, however, may not be homologous to the real beak-sculpture of other *Naiades*.

Hinge rarely with teeth, which, when present, are much reduced and consist only of pseudocardinals or irregular teeth. Real laterals are never present.

Muscle-scars on inside of shell rather variable. Generally the anterior retractor-scar is united with the adductor-scar, forming an upper continuation of it (thus differing from the normal condition seen in the *Hyriinae*). But in some cases the retractor-scar is partially or entirely isolated. Anterior protractor-scar quite variable, isolated from adductor-scar or contiguous with it, or even confluent with it. The posterior scars are rather uniform, agreeing with the *Hyriinae*, the retractor-scar forming an upper process of the adductor-scar. Only in one case (*Anodontites ensiformis*), are these two scars widely separated. Dorsal muscle-scars mostly absent; if (rarely) present, only one may be found, or (in *Leila*) a row of them. (In the *Hyriinae* several are always present.)

The pallial line is mostly simple and parallel to the margin; but in one genus (*Leila*) it forms a shallow sinus posteriorly. This undoubtedly is connected with the closing of the branchial opening in front, but unfortunately no soft parts of this genus are at hand, so that particulars cannot be given. Very often the prismatic border on the inside of the margin of the shell is unusually wide.

The ligamental sinus is comparatively large, larger than in the *Hyriinae*; it may be broad and deep, but not sharply triangular (*Iheringella*), or deep and sharply triangular (in the other genera). In *Myctopoda* it is shallow, but with a sharp lower angle.

As to the characters of the soft parts see above (p. 457). But it is well to point out here that the chief features in which this subfamily differs from the *Hyriinae* are found in the structure of the gills (text-fig. 3, *i, o*, p. 458) which have well developed, solid septa, moderately closely set, running parallel to the gill-filaments (Pl. XLVII, figs. 3, 4). In the female (Pl. XLVII, figs. 3*b*, 4*b*; text-fig. 3*i*, p. 458), the septa of the marsupial inner gill are stronger, but not distinctly more crowded than in the non-marsupial gills, and have close to the outer lamina (primary limb) a ridge on each side, projecting into the lumen of the water canal, incompletely dividing the latter into two compartments (Pl. XLVIII, figs. 6, 7*b*, 8). The inner compartment, towards the inner lamina, assumes, when charged, the function of an ovisac, containing the eggs or embryos (Pl. XLVIII, fig. 7*b*), which do not stick closely together, and this compartment expands to a certain degree, the corresponding section of the septa stretching out, while the outer compartment (close to the other lamina) retains its shape, and does not contain eggs, thus apparently serving as a secondary water-tube.

The size of the eggs is small, 0.07 to 0.09 mm. According to Von Ihering the



larval form is a *lasidium* (Size: 0.10 mm). It is a very singular circumstance that I have not been able to find lasidia (or any other form of mature larvæ) in my material, although a good many gravid females of various species and genera are at hand.

#### THE GENERA OF THE SOUTH AMERICAN MUTELINÆ.

*Mutelinæ* are found in South America and in Africa. Unfortunately, among the African forms, the anatomy of *Spatha* (including the subgenus *Aspatharia*) is alone known (Ortmann, 1910, p. 39; 1918, p. 75); but this genus differs from most South American *Mutelinæ* (*Fossula*, *Monocondylæa*, *Anodontites*) by the fact that the anal opening is closed above, without forming a supra-anal opening. In the South American genera this opening is open and not at all closed, with one exception, *Mycetopoda*, where about the upper half of the anal is closed. In addition, in *Spatha*, the inner gill is free from the abdominal sac, while in the South American genera it is connected with it. All other characters are similar. Thus, although closely allied to *Spatha*, the South American genera form a group by themselves, and the similarity of *Mycetopoda* to *Spatha* in the anal opening apparently indicates only parallelism of development, not genetic relationship.

It is hard to say which group is more primitive, since of the two differing characters, the one (anal opening) is more primitive in the American forms, the other (inner lamina of inner gill) more primitive in the African *Spatha*. The latter again is rather advanced in the shell, having no hinge-teeth, a condition which is also found in most South American *Mutelinæ*, but not in all, for *Iheringella*, *Fossula*, and *Monocondylæa* have at least pseudocardinals.

There is no question that among the South American forms, these genera with hinge-teeth should be regarded as more primitive. But a confirmation of this cannot be found in the anatomy, the latter being alike in all of them. Possibly the anatomy of *Iheringella* might furnish some enlightenment, but of this genus the soft parts have never been observed.

The structure of the hinge might be expected to furnish evidence of the connection of the *Mutelinæ* with the *Hyriinæ*. The very fact that there are genera among the *Mutelinæ* with hinge-teeth, indicates that the typical South American forms (of the *Anodontites*-type) are derived from forms with hinge-teeth. But the structure of these hinge-teeth is rather peculiar. They are always in a rudimentary condition, the laterals being missing, and the other teeth corresponding to the pseudocardinals cannot be positively homologized with the pseudocardinals of the *Hyriinæ*. Yet we are to assume on account of the many anatomical points

in common with the *Hyriinae* that the *Mutelineae* are related to, and probably descended from, the latter; but connecting links which undoubtedly stand between these two subfamilies are as yet unknown, and only the presence among the *Mutelineae* of forms with hinge-teeth suggests that there once was a closer connection with the *Hyriinae*. According to our present knowledge, the two subfamilies are undoubtedly allied; but they are very sharply separated by anatomical as well as shell-characters, and it is impossible to form an appropriate idea of their genetic connection.

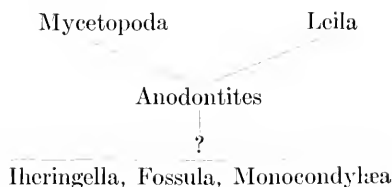
Simpson (1914, p. 1384 *et seq.*), in his family *Mutelidae*, admits six South American genera: *Monocondylaea*, *Iheringella*, *Fossula*, *Leila*, *Anodontites*, and *Mycetopoda*. These are easily distinguished by shell-characters, which are tabulated in the following key.

KEY TO THE SOUTH AMERICAN GENERA OF MUTELINÆ.

- a*<sub>1</sub>. Hinge with more or less developed pseudocardinal teeth. Lunula short or almost absent, not much produced in front of the beaks.
  - b*<sub>1</sub>. Hinge-plate rather broad, with oblique, compressed or tubercular, alternating pseudocardinals, two in each valve, the most anterior in the left valve.....*Iheringella*.
  - b*<sub>2</sub>. Hinge-plate narrow, with the pseudocardinals stumpy, squarish, or depressed, left valve never with two distinct pseudocardinals.
    - c*<sub>1</sub>. Left valve with one, right with two stumpy, or squarish, pseudocardinals, which alternate, the most anterior one being in the right valve.....*Fossula*.
    - c*<sub>2</sub>. Either valve with only one pseudocardinal, which is generally depressed (spoon-shaped), that of the left valve being the most anterior.....*Monocondylaea*.
- a*<sub>2</sub>. Hinge without any pseudocardinal-teeth. Lunula elongated and much produced in front of the beaks, forming a kind of anterior ligament.
  - b*<sub>1</sub>. Pallial line without a sinus behind.
    - c*<sub>1</sub>. Shell rounded, subovate, or subtrapezoidal. Valves closed or somewhat gaping (when the shell is elongated, the valves are closed). Anal opening entirely open. Branchial opening not closed in front. Foot normal.....*Anodontites*.
    - c*<sub>2</sub>. Shell elongated, gaping in front. Anal opening closed above. Branchial opening said to be closed in front (this is doubtful). Foot very long, developed at its distal end into a sort of button.....*Mycetopoda*.
  - b*<sub>2</sub>. Pallial line with a sinus behind. Shell large, subovate, winged. Valves gaping. Branchial opening said to be closed in front.....*Leila*.

With regard to the genetic connections of these genera, it is clear that we are to regard the first three as the more primitive forms, and, judging from the shell, *Iheringella* appears to be the most primitive, having the most complete hinge. There is no doubt that of the others *Anodontites* is the simplest, but its connection with the first three is obscure, since the shell-characters do not connect it more closely with any one of them. Both *Mycetopoda* and *Leila* seem to have descended

from *Anodontites*, the former being characterized by a specialisation of the foot; the latter by a specialisation of the branchial opening. *Mycetopoda* is also peculiar in having the anal opening closed above. We can express this in the following diagram:



The anatomy furnishes no additional help for the understanding of the phylogeny of these genera, except the points mentioned in the key. In fact, the anatomy is so disappointingly similar in all of them, that it is practically useless. Only in *Mycetopoda* and *Leila* have we been able to recognize higher stages of development in the anatomy, but it should be mentioned that I have not been able to verify this fact in *Leila*, of which I have not had the opportunity to examine soft parts. The same is true of *Iheringella*. Of *Fossula*, *Monocondylaea*, and *Anodontites*, I know the anatomy very well, but no differentiations whatever have been observed.

#### THE SPECIES OF SOUTH AMERICAN MUTELINÆ.

##### Genus IHERINGELLA Pilsbry (1893).

Pilsbry, 1893, p. 30; Simpson, 1914, p. 1392.

Characterized by rather broad hinge-plate and compressed or stumpy pseudocardinals, two in the right and two in the left valve, the anterior pseudocardinal of the left valve the most anterior of all hinge-teeth. These teeth, however, are rather variable.

This genus approaches the *Hyriinae* most closely in its hinge, but in the details of its structure it is very different from any of them. It belongs to the La Plata-drainage, and possibly also to that of the upper Amazon.

#### 41. IHERINGELLA BALZANI (Von Ihering) (1893).

*Plagiodon balzani* VON IHERING, 1893, p. 69, Pl. 3, fig. 2.

*Iheringella balzani* SIMPSON, 1900, p. 914; 1914, p. 1359.

*Type-locality*.—Rio Paraguay, near mouth of the Rio Apa, Matto Grosso, Brazil.

*New Locality*.—Rio Paraguay, San Luis de Caceres, Matto Grosso, Brazil (J. D. Haseman coll., May 25, 1909). Two complete shells and one left valve.

*Distribution.*—Known only from the upper Rio Paraguay. Simpson also gives "San Paulo, Brazil," but I do not know upon what authority.

My specimens agree well with Von Ihering's description and figure, but they are larger. Von Ihering says that the color of the epidermis is dark olive or blackish. In our largest and smallest (half-shell) specimens the surface is much corroded and worn, and brownish green. In the specimen of medium size, which is better preserved, it is yellowish green, with a few scattered dark green spots upon the disk, becoming more frequent near the beaks. Upon the posterior ridge, there are a few fine, interrupted, dark green rays, and a broader ray runs over the posterior slope.

In the two smaller specimens, the structure of the hinge corresponds entirely with Von Ihering's description. In the largest, however, the anterior tooth of the left valve is obsolete, and so is the groove between the two teeth. The posterior tooth is broad and slightly bifid. In consequence of this the groove of the right valve is also broader and has a radial ridge in its bottom, and the anterior tooth of the right valve is very small. I consider this an abnormality. In this specimen there apparently is only one (bifid) tooth in the left valve, and two small ones in the right, with an accessory ridge in the groove between them.

In all three of my specimens, the ligamental sinus is wider and shallower than figured by Von Ihering, which may be due to their greater age.

#### MEASUREMENTS.

Length.	Height.	Diameter.	Beaks.
34 mm.	26 mm. = 76 pr. ct. of L.	16 mm. = 47 pr. ct. of L.	at 9 mm. = 26 pr. ct. of L.
40 "	31 " = 78 "	21 " = 53 "	11 " = 28 "
46 "	35 " = 76 "	23 " = 50 "	12 " = 26 "
32 "	27 " = 84 "	17 " = 53 "	= 30 " (Von Ihering, beaks from figure)

The measurements given by Simpson (1914, p. 1395) are entirely wrong, and are those of *Fossula balzani* Von Ihering.

#### Genus FOSSULA Lea (1870).

Lea, Syn. 1870, p. 72, foot-note 1; Von Ihering, 1893, p. 62; Simpson, 1900, p. 914; 1914, p. 1396.

The distinguishing character of this genus is found in the hinge-teeth, of which there are two in the right valve, enclosing between them one in the left valve. The hinge-plate is narrow, the teeth are stumpy (not vertically compressed or spoon-like as in *Monocondylaea*). There are traces of additional teeth and irregularities of the hinge, which, however, are variable. The "cement processes" described by Von Ihering are not always present.

A key to the three known species has been given by Von Ihering (1910, p. 115). Two of the species are from the Paraná-drainage, and one is from a coastal river in eastern Brazil, the Rio Paraguassú in Bahia.

#### 42. FOSSULA FOSSICULIFERA (D'Orbigny) (1835).

*Section of gills:* Plate XLVIII, fig. 6.

*Monocondylaea fossiculifera* D'ORBIGNY, 1843, p. 614, Pl. 80, figs. 5-7.

*Unio fossiculiferus* SOWERBY, XVI, 1868, Pl. 96, fig. 521.

*Fossula fossiculifera* VON IHERING, 1893, p. 64, Pl. 3, fig. 2; NEHRING, 1893, p. 164;

SIMPSON, 1900, p. 914; VON IHERING, 1910, p. 115; SIMPSON, 1914, p. 1396.

*Type-locality.*—Rio Paraná, Iribueua, above Corrientes, Argentina.

*Other Localities.*—Rio Paraná and lower Rio Tieté, São Paulo, Brazil (Von Ihering); Rio Piracicaba, Piracicaba, São Paulo, Brazil (Von Ihering) (Nehring).

*Localities Represented in the Carnegie Museum.*—Rio Piracicaba, Piracicaba, São Paulo, Brazil (Von Ihering donor). One specimen. Rio Tieté, Salto de Avanhandava, São Paulo, Brazil (J. D. Haseman coll., September 15, 1908). One specimen. Rio Tieté, Salto das Cruzes, São Paulo, Brazil (J. D. Haseman coll., September 22, 1908). One female with soft parts. Rio Tieté, Itapura, São Paulo, Brazil (J. D. Haseman coll., September 28, 1908). One female with soft parts.

*Distribution.*—Rio Paraná and its tributaries from Argentina to São Paulo, Brazil.

This species has been well figured by D'Orbigny and Von Ihering, and has been well described by the latter. No further details need to be supplied.

#### MEASUREMENTS.

	Sex	Length.	Height.	Diameter.	Beaks.
Salto das Cruzes. . . . .	♀	56 mm.	44 mm. = 78 pr. et. of L.	27 mm. = 48 pr. et. of L.	at 21 mm. = 38 pr. et. of L.
Itapura. . . . .	♀	74 "	63 " = 85 "	38 " = 51 "	23 " = 31 "
Avanhandava. . . . .		79 "	62 " = 78 "	38 " = 48 "	25 " = 32 "
Piracicaba. . . . .		79 "	61 " = 81 "	39 " = 49 "	26 " = 33 "
(Von Ihering). . . . .		74 "	63 " = 85 "	38 " = 51 "	24 " = 32 "

According to Von Ihering the height varies from 80 to 85 pr. et., while in D'Orbigny's specimen it is 77 pr. et.

*Anatomy.*—Partially described by Von Ihering (1893, p. 65) for the male. I am able to supplement this from two barren females at hand.

Anal opening entirely open, very large, with smooth inner edge, very faintly crenulated in the lower part, separated by a solid mantle-connection from the

branchial opening, which has small papillæ on the inner edge. These papillæ extend rather far forward, decreasing in size, and disappearing gradually. Palpi moderately large and broad, semicircular, posteriorly with a short truncation forming the posterior margins, which are not connected.

Gills rather wide, the inner the wider, chiefly anteriorly, its anterior end immediately behind the palpi; that of the outer gill at the highest point of the attachment-line of the mantle, so that the lower margin of the outer gill is curved, the gill narrowing considerably in front, while the inner is not much narrower in front, and has the lower margin rather straight. Inner lamina of inner gill entirely connected with abdominal sac. Both gills with well developed, strong septa. The non-marsupial outer gill has the septa alternately stronger and thinner, but the alternation is irregular. The *marsupium* is in the inner gill of the female. Here the septa are more uniform and very strong, but hardly more closely set than in the non-marsupial gill. Where the septa are inserted at the outer limb, they have a swelling on each side, which forms a vertical ridge projecting into the lumen of the water-tubes (See Pl. XLVIII, fig. 6). This ridge is less developed in my younger female, yet perfectly distinct. The septa near the anterior and posterior end of the inner gill do not have marsupial structure, but the marsupial part is very large, occupying nearly the whole gill.

Genus MONOCONDYLEA D'Orbigny (1835).

D'Orbigny, 1835, p. 37; 1843, p. 611; Simpson, 1900, p. 910; 1914, p. 1384.

Normally each valve has only one pseudocardinal tooth, that of the left valve being more anterior. The teeth are more or less depressed (spoon-shaped). Traces of additional teeth may be present, but they are insignificant and variable.

A key for the species has been given by Simpson (1914, p. 1385), which, however, is artificial and unsatisfactory, and the essential characters apparently have been misunderstood. Moreover, I believe that *M. guarayana* D'Orbigny (1843, Pl. 68, figs. 4-7) does not belong here, but probably to *Iheringella*.

The specimens before me all have a cloth-like epidermis, with crowded, irregular and anastomosing, concentric lines, which are lamellarly elevated. But very often these fine lamellæ are abraded, so that the surface appears smooth. Nevertheless the lamellæ are generally preserved in some part of the shell, chiefly on the posterior slope and near the margins, and, even when abraded, they can be easily noticed as fine lines. The species at hand, which have been treated by Simpson have been called "smooth or lightly concentrically striate." He distinguishes them according to the outline, orbicular, obovate, elliptical, subrhomboidal, or subquadrate, but it is extremely hard to draw a line between these terms.

The following key is intended only for the distinction of the forms at hand.

KEY TO THE SPECIES OF MONOCONDYLÆA.

- a*<sub>1</sub>. Shell small, or of medium size (at the utmost 50 to 60 mm. long). Lamellar striae of epidermis well developed, but sometimes abraded. Color of epidermis greenish black or brown.
- b*<sub>1</sub>. Shell more or less oblique, subtrapezoidal, or angularly suborbicular, with a well developed posterior upper angle, high behind, narrower in front. Color of epidermis greenish black. Prismatic zone on inside of margin of unequal width, very wide along anterior portion of lower margin.
- c*<sub>1</sub>. Shell angularly suborbicular, rather high and short, height about 80 pr. et. of length. Sides of disk not flattened.
- d*<sub>1</sub>. Shell compressed, diameter 50 pr. et. or less of length. Beaks not much elevated. *M. lentiformis*.
- d*<sub>2</sub>. Shell more swollen, diameter 58 to 59 pr. et. of length. Beaks more inflated and elevated. *M. paraguayana*.
- c*<sub>2</sub>. Shell subtrapezoidal, more elongated, height about 70 pr. et. of length. Sides of disk more or less flattened.
- d*<sub>1</sub>. Shell more swollen, beaks more prominent, hinge-line rather strongly incurved under the beaks. *M. minuana*.
- d*<sub>2</sub>. Shell less swollen, beaks less prominent, hinge-line less incurved under the beaks. *M. minuana parhappi*.
- b*<sub>2</sub>. Shell very little, or not at all oblique, subovate or subelliptical in outline, with the posterior upper angle rounded and poorly developed. Obesity of shell very great, and beaks much swollen and inflated. Color of epidermis brown. Prismatic zone on inside of margin narrow and of nearly uniform width. *M. obesa*.
- a*<sub>2</sub>. Shell large (about 100 mm. long). Lamellar striae of epidermis poorly developed upon the disk, distinct only near the margins. Color of epidermis from yellowish olive upon the disk and toward the beaks to dark brown toward the margins. *M. hollandi*.

The species of this genus cover a rather large range in South America being found all over the La Plata-drainage, in the Amazon-drainage in Bolivia and Brazil, in the Rio San Francisco in eastern Brazil, and also in coastal streams in southern Brazil (Rio Grande do Sul).

43. MONOCONDYLÆA LENTIFORMIS Lea (1866).

*Anatomy of gills:* Plate XLVII, fig. 3.

*Monocondylaea lentiformis* LEA, Obs., XII, 1869, Pl. 36, fig. 86; PILSBRY & RUSH, 1896, p. 81; SIMPSON, 1900, p. 912; 1914, p. 1392; CORSI, 1901, p. 452; HAAS, 1916, pp. 25, 54.

*Aplodon lentiformis* VON IHERING, 1893, p. 67; NEHRING, 1893, p. 164.

*Type-locality.*—South America.

*Other Localities.*—Rio Piracicaba, Piracicaba, São Paulo, Brazil (Von Ihering) (Nehring); Rio Uruguay, Salto Oriental, Uruguay (Haas); Rio de la Plata, Colonia, Uruguay (Pilsbry & Rush).

*New Localities.*—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 5, 1909). Four specimens with soft parts, males and females. Rio Cacequy, Cacequy, Rio Grande do Sul, Brazil (tributary to Rio Ibicuhy, to Uruguay) (J. D. Haseman coll., February 2, 1909). Two specimens with soft parts, male and female. Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil (tributary to Rio Guahyba) (J. D. Haseman coll., January 26, 1909). Two specimens.

*Distribution.*—Known from the Rio de la Plata, and up the Uruguay, and from the upper Paraná drainage in São Paulo. The species has not been found in the lower and middle Paraná, although it should be expected there. In addition it is found, as our specimens show, in the drainage of a coastal stream in Rio Grande do Sul (Guahyba). This is a remarkable fact, but it should be borne in mind that the head-waters of the Ibicuhy (Uruguay drainage) and those of the Jacuhy (Guahyba-drainage) closely interlock, and that stream piracy in this region is quite probable.

*Characters of the Shell.*—Shell rather small (maximum length 44 mm.), moderately thick, outline more or less subcircular or subpolygonal. Height 77 to 88 pr. et. of length. Valves very little gaping in front, sometimes almost closed. Dorsal margin straight behind the beaks, or gently convex, much lower in front of the beaks, and straight here or even somewhat concave, passing in a curve or a very blunt angle into the anterior margin. Posteriorly the dorsal margin passes in a distinct, or indistinct, blunt angle into the posterior margin. The latter descends obliquely, and is straight, rarely slightly convex or concave. It passes in a curve into the posterior part of the lower margin, forming the blunt posterior end of the shell. The lower margin is curved, the strongest part of the curve and the lowest point of the shell is situated at 54 to 60 pr. et. of the length from anterior end, and is thus immediately behind the middle. From this point the lower margin curves up rather strongly in the posterior part. In the anterior portion it is very gently curved, or almost straight, and finally curves up sharply into the anterior margin. Thus the anterior end of the shell appears narrower than the posterior, and the shell has the shape of an irregular pentagon.

Valves very gently convex, rather compressed, greatest convexity behind the middle of the shell, without a distinct posterior ridge. Sides not flattened. Toward the anterior and posterior end the shell is somewhat compressed. Diameter 41 to 51 pr. et. of the length. Beaks little swollen, and very little prominent, located at 31 to 39 pr. et. of the length. Lunula narrow and short.

Epidermis dull, not shining, with very crowded, irregular concentric lines, which form fine lamellæ, and give a cloth-like appearance to the surface. But



these lamellæ may be worn off in part, and the surface may be smoother. No distinct radial sculpture is visible, but there may be a trace of a radial rib upon the posterior slope. Color of epidermis blackish green, without color-markings, except traces of one or two dark rays upon the posterior slope.

Hinge-line straight behind the beaks. In front it is curved down more or less suddenly, and carries a single pseudocardinal tooth in each valve. The tooth of the left valve stands in front of, and somewhat below, that of the right valve. Both teeth are vertically depressed, somewhat spoon-shaped, and project under the edge of the opposing valves into corresponding shallow grooves. Ligamental sinus triangular, not deeper than wide; its anterior margin more or less oblique to the hinge-line.

Nacre very iridescent, whitish, but generally with salmon, pink, or pale purple stains, chiefly in the cavity of the shell. Irregular radiating lines present, but only near the margin. Nacreless (prismatic) zone of irregular width, narrow behind, suddenly increasing in width at the lower point of the lower margin, and remaining wide to near the anterior margin. Greatest width of this zone over half the distance of mantle-line from margin. Color of nacreless zone dull olive, grayish, or grayish red.

Cavity of shell and beaks shallow. Anterior adductor-scar well marked, ovate. Anterior retractor-scar small, but distinct, separated from or connected with the adductor-scar, lying in the left valve on the base of the pseudocardinal tooth. Anterior protractor-scar connected with adductor-scar. Posterior adductor-scar faint, ovate; posterior retractor-scar forming a triangular upper projection of adductor-scar. No dorsal scars. Pallial line subconcentric to the margin.

## MEASUREMENTS.

Localities.	No.	Sex	Length.	Height.	Diameter.	Beaks.	Greatest Height.
Cachoeira . . .	1	?	34 mm.	27 mm. = 79' of L.	14 mm. = 41' of L.	at 11 mm. = 32' of L.	at 20.5 mm. = 60' of L.
Uruguayana . .	1	♂	38 " "	31.5 " = 83 "	18 " = 47 "	15 " = 39 "	22 " = 58 "
Cacequy . . . .	2	♂	39 " "	30 " = 77 "	16 " = 41 "	13 " = 33 "	23 " = 59 "
Do. . . . .	1	♀	39 " "	31 " = 79 "	18 " = 46 "	13 " = 33 "	23 " = 59 "
Uruguayana . .	3	♀	39 " "	34.5 " = 88 "	19.5 " = 50 "	14 " = 36 "	21 " = 51 "
Do. . . . .	2	♂	41 " "	33.5 " = 82 "	18 " = 44 "	13 " = 32 "	21 " = 59 "
Do. . . . .	4	♀	42 " "	36 " = 86 "	20.5 " = 49 "	15 " = 36 "	23 " = 55 "
Cachoeira . . .	3	?	43 " "	34 " = 79 "	19 " = 44 "	13.5 " = 31 "	25 " = 58 "

*Remarks.*—These measurements agree well with those given by Von Ihering and Nehring. According to Von Ihering the height ranges from 80 to 84 pr. et. of length, the diameter from 46 to 51 pr. et., while Nehring gives for the height 77 to 82 pr. et., the diameter 46 to 49 pr. et. Lea's original figure shows, according to Von Ihering, 80 pr. et. for the height, and 44 pr. et. for the diameter. The speci-

mens from Cachocira (Guahyba-drainage) entirely correspond with the others in these respects, and I cannot distinguish them by any other characters.

The chief features of this species are the subcircular, or rather rounded-pentagonal outline, the great height of the shell, the location of the greatest height close behind the middle of the shell, and the flatness of the valves. If properly placed, with the ligament horizontal, it is seen that the shell is distinctly oblique, and that the anterior end is narrower.

*Anatomy.*—Three males and three barren females are at hand.

Von Ihering (1893, p. 69) has mentioned a number of anatomical characters, but his account is not complete.

Anal opening entirely open, large, its inner edge with distinct crenulations in the lower part, otherwise smooth, separated from the branchial opening by a mantle-connection. Inner edge of branchial opening with distinct, but small, papillæ. Palpi moderately large, semicircular, briefly truncated behind, the posterior margins not connected.

Gills (Pl. XLVII, figs. 3*a*, *b*) of medium width, the inner the wider, chiefly in front; the outer narrowing anteriorly, its anterior end near the highest point of the mantle-attachment-line. The inner gill very little narrowed in front, beginning immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac.

Gills with well developed septa. Those of the male (Pl. XLVII, fig. 3*a*) and of the outer gill of the female alternately stronger and weaker. This alternation, however, is not very distinct, and is chiefly seen in the middle of the gill. In the female (Pl. XLVII, fig. 3*b*) the inner gill is marsupial, with the septa more uniform and stronger, but hardly more crowded. At the point of union with the outer lamina, the usual swelling is present, indicating the ridges projecting into the water tubes. The most anterior and most posterior extremity of this gill has not the marsupial structure, but the marsupium occupies nearly the whole gill.

In the specimen sectioned, the swellings of the septa are located nearly in the middle. However, the part of the septa from the swelling toward the inner lamina is thicker, and has more strongly developed epithelium, indicating that this is the part which stretches out, when gravid. The condition seen in this specimen undoubtedly is due in part to its barren character, in part to the state of preservation.

## 44. MONOCONDYLÆA PARAGUAYANA D'Orbigny (1835).

*Monocondylæa paraguayana* D'ORBIGNY, 1843, p. 612, Pl. 70, figs. 5-7; SIMPSON, 1900, p. 911 (in part); 1914, p. 1387.

*Unio paraguayana* SOWERBY, XVI, 1866, Pl. 52, fig. 273.

*Type-locality*.—Rio Paraná, Itaty, near Corrientes, Argentina.

*Other Locality*.—Rio Batel, Province Corrientes, Argentina.

*New Locality*.—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 5, 1909). One female with soft parts.

*Distribution*.—Known from Rio Paraná and its tributary, the Rio Batel in Argentina, and from the Rio Uruguay.

*Characters of Shell*.—Shell moderately thick, and of medium size (maximum length 59 mm.). Outline briefly subtrapezoidal, rather high (height 77 to 81 pr. et. of length), distinctly oblique, but approaching an angularly suborbicular shape. Valves in front gaping very little. Dorsal margin behind the beaks slightly convex, much lower in front of the beaks, where it is distinctly concave, and passes into the anterior margin in a blunt, but distinct, angle. Posteriorly the dorsal margin passes into the posterior margin in a rather sharp curve, forming a blunt angle. Posterior margin descending obliquely, but very steeply, almost straight, and curving into the lower margin, forming with it the broadly rounded posterior end of the shell. Lower margin very little curved in the anterior part and sloping upward; posteriorly more distinctly curved. Its lowest point (and the greatest height of the shell) at about 57 pr. et. of the shell (60 pr. et. according to D'Orbigny's figure). In front, the lower margin curves up into the anterior margin. The anterior end of the shell is narrower than the posterior, thus producing the oblique shape.

Valves very convex, chiefly so in the anterior part and backward to the posterior ridge, and without any flattening upon the sides. Behind the posterior ridge the shell is strongly compressed, so that the posterior slope and the upper posterior angle appear almost alate. The most extreme anterior end of the shell is also slightly compressed. Diameter 59 pr. et. of the length (58 pr. et. according to D'Orbigny). Beaks inflated and swollen, incurved, projecting over the lunula, but only slightly elevated above the posterior part of the upper margin. Lunula distinct, short, triangular, about half as wide as long.

Epidermis dull, with crowded, irregular, concentric lines, which frequently become lamellar: probably, where not lamellar, they are worn off, and originally the whole epidermis was cloth-like. No radial sculpture visible. A radial rib upon the posterior slope, but rather indistinct (much less distinct than in D'Or-

bigny's figure, and hardly forming a point and an emargination on the posterior margin, as in this figure). Color of epidermis dark grayish green to blackish, the grayish green shade due to the preservation of the lamellæ. A rather distinct black radial ray upon the rib of the posterior slope, and faint traces of additional rays in front of and behind it.

Hinge gently curved behind the beaks. Under the beaks it is sharply curved down, and in front of them it curves up again, thus becoming concave. Each valve has a single pseudocardinal tooth of the typical shape; that of the left valve anterior to, and a little below, that of the right; both triangular and depressed, and projecting under the margin of the opposite valve, where they fit into shallow grooves. Ligamental sinus triangular, wider than deep, its anterior margin oblique to the hinge-line.

Nacre very iridescent, whitish, with a faint salmon blush in the cavity of the shell, and purple and greenish reflections toward the margins. Irregular radiating lines are present toward the margin. Prismatic zone of unequal width, rather narrow behind, widening quite suddenly at the lowest point of the shell, and remaining wide along the anterior ascending part of the lower margin, narrowing again at the anterior end. Color of prismatic zone grayish green.

Cavity of shell and beaks moderate. Anterior adductor-scar deep, elliptical. Anterior retractor-scar small, at the upper end of the adductor-scar, distinctly isolated in left valve, narrowly connected with it in the right. Anterior protractor-scar small and united with adductor-scar. Posterior adductor-scar faint, subovate, with an upper triangular projection formed by the posterior retractor-scar. No dorsal scars. Pallial line subconcentric to the margin.

#### MEASUREMENTS.

Sex.	Length.	Height.	Diameter.	Beaks.	Greatest Height.
♀	53 mm.	43 mm. = 81 pr. et. of L.	31 mm. = 59 pr. et. of L.	at 16 mm. = 30 pr. et. of L.	at 30 mm. = 57 pr. et. of L.

*Remarks.*—In general outline this species is much like *M. lentiformis*, as is shown by the proportion of height to length and the location of the greatest height of the shell. It markedly differs, however, in the much more swollen shell (diameter 59 pr. et. as against 41 to 51 pr. et. in *lentiformis*), and the more inflated beaks. In consequence of the very convex disk, the posterior slope appears much more compressed and alate.

*Anatomy.*—The specimen at hand for examination is a barren female.

The structure is absolutely identical with that of *M. lentiformis*, and nothing is to be added, except that the crenulations of the lower part of the anal opening

are less distinct, and that the palpi appear a little larger, with longer posterior margins, which are connected at the base. These differences, however, may be due to preservation.

The septa of the inner marsupial gill also have the characteristic swelling, not so close to their insertion with the outer lamina, but more toward the middle of the septum.

45. *MONOCONDYLÆA MINUANA* D'Orbigny (1835).

*Section of gills:* Plate XLVIII, fig. 7.

*Monocondylæa minuana* D'ORBIGNY, 1843, p. 612, Pl. 70, figs. 8-10; CORSI, 1901, p. 452, fig. 34; SIMPSON, 1914, p. 1388.

*Unio minuanus* SOWERBY, XVI, 1868, Pl. 91, fig. 497.

*Monocondylæa pazii* LEA, Obs., XII, 1869, Pl. 36, fig. 88; PILSBRY & RUSH, 1896, p. 81.

*Monocondylæa paraguayana* SIMPSON, 1900, p. 911 (*pro parte*).

*Type-locality.*—Canelon Grande and del Rosario, Banda Oriental, Uruguay (Arroyo Grande flows North to Rio Negro; Arroyo Rosario flows South to Rio de la Plata).

*Other Localities.*—Arroyo de las Vacas, Uruguay (Corsi); Rio de la Plata, Colonia, Uruguay (Pilsbry & Rush, *pazii*).

*New Localities.*—Rio Uruguay, (in mud) Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 5, 1909). Five specimens with soft parts, males and females. Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 26, 1909). Five specimens with soft parts, males and females.

*Distribution.*—Rio de la Plata and its tributaries in the Banda Oriental; Rio Uruguay and Rio Negro drainages; and in Guahyba drainage in Rio Grande do Sul.

*Characters of the Shell.*—Shell moderately thick, rather small (maximum length 55 mm.). Outline subtrapezoidal, strongly oblique, rather elongated (height 67 to 72 pr. et. of length). Valves very slightly gaping at anterior end. Dorsal margin straight behind the beaks, or gently convex, much lower in front of beaks, where it may be straight or somewhat concave, forming with the anterior margin a more or less distinct, obtuse angle. Posteriorly the dorsal margin passes into the posterior margin in a more or less distinctly obtuse angle. Posterior margin obliquely descending, straight, or gently curved, passing into the lower margin in a strong curve, which forms the rounded lower posterior end of the shell, not much elevated above the base-line. Lower margin in its middle and anterior part

very gently curved or almost straight, sloping upward; the lowest point located rather far backward (at 66 to 77 pr. ct. of the length). Anteriorly and posteriorly the lower margin curves up into the anterior and posterior margins. Anterior end of shell markedly narrower than the posterior.

Valves very convex, but distinctly flattened upon the sides of the disk, which flattening may even become a shallow depression. Greatest convexity in front and behind the flat area, and the posterior convexity, forming the rounded posterior ridge, is the stronger. Posterior slope somewhat compressed and elevated, but hardly alate. At its anterior end the shell is also a little compressed. Diameter 50 to 56 pr. ct. of length, but sometimes falling below 50 pr. ct., and such specimens approach the var. *parchappi*. Beaks more or less swollen, inflated, and incurved, prominent over the lunula, but only little elevated above the posterior part of the upper margin. Lunula distinct, short, elongated triangular, variable, narrower in young, broader in old specimens, where it may be half as wide as long.

Epidermis dull, cloth-like. Fine and crowded, anastomosing, concentric striae are elevated as fine lamellae, but often they are abraded. No radial sculpture visible, and there is hardly a trace of a radial ridge upon the posterior slope. Color of epidermis dark grayish green, without any trace of color-markings, except occasionally a mere indication of a dark ray upon the posterior slope.

Hinge straight, or gently curved, in its posterior part. Under the beaks it curves down more or less suddenly, and then becomes straight again, or even somewhat concave. The curvature of the hinge-line is quite variable, and corresponds to the varying degree of the development of the beaks. Pseudocardinal teeth as in *M. paraguayana*. Ligamental sinus triangular, wider than deep, with its anterior margin oblique to the hinge-line.

Nacre very iridescent, whitish, with greenish and purplish tints, chiefly posteriorly. Irregular radiating lines present, but faint in old specimens. Prismatic zone of unequal width, rather narrow behind, suddenly widening at the lower point of the lower margin, and remaining wide to near the anterior margin. However this widening is not so strongly pronounced as in *M. paraguayana*, and is also individually variable. Color of prismatic zone greenish gray.

Cavity of shell and beaks moderate. Anterior adductor-scar sharply and rather deeply impressed, subelliptical; anterior retractor-scar small, connected with, or separated from, adductor-scar; anterior protractor-scar connected with adductor-scar. Posterior adductor-scar distinct, but less strongly impressed; scar of the posterior retractor forming a short, triangular upper process of it, which, in a few specimens, is partly separated from it. No dorsal scars. Pallial line distinct, subconcentric to the margin.

## MEASUREMENTS.

Localities.	No.	Sex.	Length.	Height.	Diameter.	Beaks.	Greatest Height.
Uruguay- ana. . . . .	1	♂	24 mm.	17 mm. = 71% of L.	12 mm. = 50% of L.	at 9 mm. = 38% of L.	at 18.5 mm. = 77% of L.
Do. . . . .	3	♀	35 "	25 " = 71 "	17.5 " = 50 "	12 " = 34 "	25 " = 71 "
Do. . . . .	6	♀	39 "	28 " = 72 "	22 " = 56 "	14 " = 36 "	27 " = 69 "
Do. . . . .	5	♂	41 "	28 " = 68 "	21 " = 51 "	14 " = 34 "	27 " = 66 "
Do. . . . .	7	♂	48 "	33 " = 69 "	24 " = 50 "	15 " = 31 "	33 " = 69 "
Cachoeira. .	1	♂	28 "	19.5 " = 70 "	12.5 " = 45 "	9.5 " = 34 "	18.5 " = 66 "
Do. . . . .	2	♀	34.5 "	23 " = 67 "	16.5 " = 48 "	11 " = 32 "	23 " = 67 "
Do. . . . .	x	?	36 "	27 " = 75 "	16.5 " = 46 "	11 " = 31 "	25 " = 69 "
Do. . . . .	3	♀	43 "	30 " = 70 "	22 " = 51 "	13 " = 30 "	29 " = 67 "
Do. . . . .	4	♀	44 "	30.5 " = 69 "	21.5 " = 49 "	12 " = 27 "	29 " = 66 "

*Remarks.*—The measurements for *minuana* given by D'Orbigny in the text and those taken from his figures do not agree, but according to the latter the height is about 64 to 67 pr. et. of length, and the diameter about 50 pr. et. Our specimens from Cachoeira have, on the average, a smaller diameter (falling as low as 45 pr. et.), and in this respect they are transitional toward the variety *parchappi*; but in other characters (beaks and hinge-line) they agree better with typical *minuana*.

*M. pazi* Lea is apparently the same species. Simpson unites it with *parchappi*, and it indeed approaches the latter in obesity, having a diameter of 46 pr. et., (*parchappi* of D'Orbigny has 43 pr. et.), but here again the beaks and the curvature of the hinge-line are more like *minuana*, and for this reason I place it here.

Just because such intergrades do exist, I regard *parchappi* as a variety of *minuana* (See below). Where the line between the two forms should be drawn remains doubtful, and naturally it could not be expected that there is a *sharp* line. I have named as *minuana* my specimens with the diameter of 45 pr. et. and over, because their beaks and hinge-line are more like those of *minuana*, but this procedure possibly may require modification, when more material is studied.

*Anatomy.*—I have examined the soft parts of six males, and of five females. Two of the latter, collected February 5 (Uruguayana), were gravid.

Lea (Obs. XII, 1869, p. 273) has described the soft parts of *M. pazi*, and, as far as it goes, this description agrees with our specimens.

The structure of the soft parts is essentially like that of the foregoing species (*lentiformis* and *paraguayana*). It should be remarked that the palpi are rather large, with a somewhat longer posterior truncation, and the posterior margins are connected at the base. Anal opening practically smooth. Papillæ of the branchial opening very small.

In the gravid female the whole inner gill is charged, with exception of the outermost extremities. The swelling of the *marsupium* is very moderate, and in a cross-section (Pl. XLVIII, fig. 7b) it is seen that only the part of the septa, extend-

ing from the swellings, toward the inner lamina (secondary limb) stretch out, and that the egg-masses are located only in this part of the water-tubes, while the part toward the outer lamina (primary limb) does not contain eggs, and forms what should be called *secondary water-tubes*. In the sterile female the swelling of the septa (vertical ridges projecting into the water tubes) are located as usual. In the cross-section of the gills of the male (Pl. XLVIII, fig. 7a) it is seen, chiefly in the inner gill, that the alternation of stronger and weaker septa is due to the alternating presence or absence of a larger blood-vessel at the point where the septum connects with the primary limb. In the marsupial gill of the female this is obscured in the direct view by the development of the ridges, so that the septa appear more uniform.

The contents of the charged marsupium consist of small globular embryos in an early stage of development. No lasidia were seen. Von Ihering (1891, p. 480) mentions the eggs of *Aplodon pazi*. They are small, 0.075 mm. in diameter.

45a. *MONOCONDYLEA MINUANA PARCHAPPI* (D'Orbigny) (1835).

*Monocondylaea parchappi* D'ORBIGNY, 1843, p. 615, Pl. 68, figs. 1-3; SIMPSON, 1900, p. 911; 1914, p. 1386; HAAS, 1916, pp. 24, 54.

*Type-locality*.—Rio Paraná, Itaty, Province Corrientes, Argentina.

*Other Locality*.—Rio Uruguay, Salto Oriental, Uruguay (Haas).

*New Locality*.—Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil (J. D. Hase-man coll., January 26, 1909). One specimen, male with soft parts.

*Distribution*.—Rio Paraná and Rio Uruguay, and also Guahyba-drainage. The distribution resembles that of *M. minuana*.

D'Orbigny has already pointed out the close resemblance of this form to *M. minuana*, but gives as differentiating characters the greater compression of the shell, the less elevated and less incurved beaks, the absence of a lunula, and the rose-colored naere. We may dismiss the last two characters as unimportant, since the lunula is variable and generally less developed in forms with lower beaks; and since reddish naere is found as an individual variation in other species of *Monocondylaea*. But the greater compression of the shell and the feebler development of the beaks is striking. In D'Orbigny's figure, as well as in my specimen, the latter character is connected with a straighter hinge-line, which is much less incurved below the beaks.

We have seen that specimens of *minuana* sometimes approach *parchappi* in the less pronounced obesity. The same may be said of the inflation of the beaks and the curvature of the hinge-line. However, none of my specimens recorded as



*minuana* from Cachocira have the beaks as low and the hinge-line as straight as the specimen placed under *parchappi*. But there is no question that they incline in this direction, and that beaks and hinge-line are quite variable in *minuana*. Thus these two forms should be regarded as varieties of one species, actually connected by intergrades.

## MEASUREMENTS.

Sex.	Length.	Height.	Diameter.	Beaks.	Greatest Height.
♂	41 mm.	29 mm. = 71 pr. et. of L.	17 mm. = 41 pr. et. of L.	at 12 mm. = 29 pr. et. of L.	at 26 mm. = 63 pr. et. of L.

According to D'Orbigny, *parchappi* has a height of 64 pr. et. and a diameter of 43 pr. et., so that length and diameter are a little greater than in my specimen.

*Anatomy*.—The specimen at hand is a male according to the soft parts. The structure is absolutely identical with that of the males of *M. minuana*.

## 46. MONOCONDYLEA OBESA Ortmann, sp. nov.

*Shells*: Plate XL, figs. 4, 5, 6.

*Type-locality*.—Rio Tapajos, Santarem, Pará, Brazil (J. D. Haseman coll., December 6–12, 1919). *Type-set*: Carn. Mus. Cat. No. 61.5850. Seventeen complete shells and a number of odd valves.

*Characters of Shell*.—Shell small to medium in size (maximum length 57 mm.), moderately thick, outline briefly subelliptical, subovate, or subrotund (when young), hardly oblique. Height 75 to 86 pr. et. of the length. Valves not gaping. Dorsal margin behind the beaks gently curved or almost straight, subconcave and very short in front of the beaks, passing gradually or at an indistinct angle into the anterior margin. Posteriorly the dorsal margin passes by a blunt, indistinct angle, or almost gradually, into the posterior margin, which descends obliquely and is gently curved. At the lower posterior end, which is little elevated above the base line, the posterior margin passes in a stronger curve into the lower margin. Lower margin very gently curved in its posterior part, sometimes almost straight and subparallel to the upper margin, so that a lowest point cannot be located. From about the middle it slopes upward, increasing the curve until it passes into the anterior margin. Thus the anterior part of the shell appears only little narrower than the posterior.

Valves very convex, convexity rather uniform over the disk, slightly stronger over the posterior ridge, which is indistinct. The posterior slope is very slightly compressed, without forming a wing-like expansion. Diameter 60 to 69 pr. et. of the length. Beaks much swollen and inflated, incurved, strongly elevated over

the lunula, and distinctly higher than the posterior upper margin, located at 28 to 33 pr. ct. of the length. Lunula cordiform, short and broad, almost as broad as long.

Epidermis dull, with crowded, irregular, concentric lines. My specimens being all dead shells, the original structure is somewhat doubtful, but in some specimens there are distinct indications of a lamellar, cloth-like structure. No radial sculpture present, and no distinct radial rib upon the posterior slope. Color of epidermis paler or darker brown, rather uniform, often with a more or less distinct blackish ray upon the posterior slope, sometimes accompanied by a second ray.

Hinge-line gently curved or almost straight behind the beaks. Under the beaks it is sinuated, curving down more or less strongly, and then it is straight or may curve up a little, rendering the lunula slightly concave. Pseudocardinal teeth of the usual type, but somewhat variable; that of the right valve in particular may be more or less compressed. Ligamental sinus rather small, triangular, its anterior margin oblique.

Nacre white, shining in well preserved shells, iridescent, and with rather distinct radial lines. Prismatic zone narrow, without any trace of a sudden widening. Cavity of shell and beaks considerable. Anterior adductor-scar deeply impressed. Anterior retractor-scar small, close to the adductor-scar, but distinctly separated from it. Anterior protractor-scar united with adductor-scar. Posterior adductor-scar faint, subovate, with a triangular upper process formed by the posterior retractor-scar. No dorsal scars. Pallial line subconcentric to the margin.

## MEASUREMENTS.

No.	Length.	Height.	Diameter.	Beaks	Figured.
1....	22 mm.	18 mm. = 82 pr. ct. of L.	14 mm. = 64 pr. ct. of L.	at 6.5 mm. = 30 pr. ct. of L.	Pl. XL, fig. 6.
5....	28 "	24 " = 86 "	19 " = 68 "	8 " = 29 "	Pl. XL, fig. 5.
7....	30 "	25 " = 83 "	18 " = 60 "	9 " = 30 "	
10....	41 "	33 " = 80 "	27 " = 66 "	13.5 " = 33 "	Pl. XL, fig. 4.
11....	49 "	39 " = 80 "	34 " = 69 "	14 " = 29 "	
12....	57 "	43 " = 75 "	35 " = 61 "	16 " = 28 "	

*Remarks.*—There cannot be any mistake about this species, which differs from all others by the greatly swollen valves and inflated beaks, which render the shape almost subglobular. The diameter of 60 to 69 pr. et. is not found in any other species of the genus, and approached only by *M. paraguayana*, which, however, distinctly differs in shape, being subangular, strongly oblique, and having the posterior slope much compressed and subalate. In addition, the present species differs from others by the narrow prismatic zone. It is impossible to give exact figures for the location of the greatest height, as the height of the shell is essentially the same for a considerable distance behind the middle.

Only one of the described species comes near to the present one, and this is the little known *M. inermis* (Spix), as re-described by Von Ihering (1890, p. 126, Pl. 9, figs. 1-3). This is founded upon a single, and apparently very young, individual, which resembles to a degree our youngest specimens of *obesa*. Von Ihering gives the following figures for this:

Length.	Height.	Diameter.
21 mm.	15 mm. = 71 pr. ct. of L.	10 mm. = 48 pr. ct. of L.

This specimen is not so high, and much less swollen than *obesa*, and we could not by any means place it at the head of our table of measurements.

#### 47. MONOCONDYLEA HOLLANDI Ortmann, sp. nov.

*Shell*: Plate XLI, fig. 1.

*Type-locality*.—Sand-bar of Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil. (J. D. Haseman coll., July 20, 1909). *Type*: Carn. Mus., Cat. No. 61. 5846. One specimen, male, with soft parts.

*Characters of the Shell*.—Shell large (length 102 mm.) moderately thick, outline subcircular, almost subrhomboidal. Height 77 pr. ct. of length. Valves very little gaping, almost closed in front. Dorsal margin behind beaks practically straight, in front of them subconcave, short and much lower, passing by a very blunt angle into the anterior margin. The angle with the posterior margin is also very blunt, almost regularly rounded. Posterior margin obliquely descending and gently curved, passing in a sharper curve into the lower margin, thus forming the rounded posterior end of the shell, which is situated a good deal above the baseline. Lower margin curved, strongest curve in about the middle of the shell, forming a blunt lowermost point at 47 pr. ct. of the length (consequently a little in front of the middle). From this point the lower margin slopes up in either direction; the posterior part of the margin is almost straight; the anterior more curved, and passes in a regularly increasing curve into the anterior margin. The anterior end of the shell cannot be called narrower than the posterior.

Valves gently and regularly convex in the middle of the disk, and more so towards the beaks, distinctly compressed anteriorly and posteriorly, and the anterior compression is quite remarkable, forming a sharp, elevated, almost wing-like expansion at the anterior upper margin. Posterior ridge of shell not at all marked. Diameter 45 pr. ct. of length. Beaks somewhat inflated, not very prominent (they are eroded), located at about 37 pr. ct. of the length. Lunula short and broad.

Epidermis smooth, with irregular, concentric lines, poorly developed in the

middle of the disk and toward the beaks, slightly lamellar and more crowded on the posterior slope and near the lower margin. Upon the main part of the disk there are traces of indistinct radial lines. Posterior slope with an indistinct radial ridge. Color of epidermis yellowish brown, lighter in anterior half of the shell, darker in the posterior, the two colors divided by a rather distinct radial boundary-line through the middle of the shell. No color-rays are visible.

Hinge-line straight behind the beaks. In front it is curved down, and then it slopes up again, making the lunula slightly concave. One pseudocardinal tooth in each valve, that of the left valve standing in front of, and slightly below, that of the right. The former is vertically depressed and projects into a slight groove of the right valve. This groove has a low horizontal ridge, fitting into a groove at the base of the upper face of the tooth of the left valve; however, this may be an individual character. Tooth of the right valve subpyramidal, not depressed, projecting and fitting into a groove which is partly under the margin of the left valve (the stumpy character of this tooth may also be individual). Ligamental sinus triangular, about as deep as wide, its anterior margin oblique to the hinge-line.

Nacre white, not very iridescent,<sup>26</sup> with hardly any traces of radial lines. Prismatic zone comparatively narrow, slightly wider in the anterior part of the shell, but not abruptly widening anywhere.

Cavity of shell shallow, that of beaks moderate. Anterior adductor-scar sharply marked, elliptical. Anterior retractor-scar above it and close to it, but separated; in the right valve it appears double. Anterior protractor-scar connected with adductor-scar. Posterior adductor-scar less sharply marked, subovate, with a triangular process above formed by the posterior retractor-scar. No dorsal scars. Pallial line subconcentric to margin.

## MEASUREMENTS.

$\frac{W}{L}$	Length.	Height.	Diameter.	Beaks.	Greatest Height.	Figured.
$\sigma^3$	102 mm.	79 mm. = 77 pr. ct. of L.	46 mm. = 45 pr. ct. of L.	at 38 mm. = 37 pr. ct. of L.	at 48 mm. = 47 pr. ct. of L.	Pl. XLI, fig. 1.

*Remarks.*—A very striking and certainly new species, although only a single individual is at hand. It is much larger than any of the known species, and has a shape characterized chiefly by the location of the greatest height in front of the middle, and the absence of a distinct narrowing of the anterior part of the shell.

<sup>26</sup> The nacre apparently is slightly corroded. Although the specimen was alive when found, and preserved with the soft parts, the uppermost layer of the nacre has been injured and is exfoliating. According to my experience, this happens when specimens are allowed to die before they are put in alcohol.

It is also remarkable for the yellowish brown color of the epidermis, but this may be variable. In the relative dimensions it comes near *M. lentiformis* (height and diameter), and it is also a decidedly flat shell, although the beaks are slightly more inflated than in *lentiformis*. The compression of the anterior extremity also should be noted.

I name this species in honor of Dr. W. J. Holland, Director of the Carnegie Museum, under whose auspices the expedition to Central South America by Mr. John D. Haseman was made.

*Anatomy*.—The specimen at hand is a male.

Soft parts like those of the foregoing species, but the following points should be mentioned: the inner edge of the anal opening is practically smooth, that of the branchial opening with very minute papillæ, which appear as mere crenulations; the gills have solid septa, which are unequal in thickness, heavier and lighter ones alternating in a more or less regular way, chiefly so in the middle of the gills.

#### Genus ANODONTITES Bruguière (1792).

*Anodontites* BRUGUIÈRE, Journ. Hist. Nat., Paris I, 1792, p. 131; PILSBRY, 1911, p.

609; ORTMANN, 1911c, p. 91; SIMPSON, 1914, p. 1403.

*Patularia* SWAINSON, Malacology, 1840, p. 287, 381.

*Glabaris* GRAY (1847) SIMPSON, 1900, p. 916.

In this genus the hinge is without any teeth. From *Myctopoda* and *Leila* it differs by the absence of the characters peculiar to these, *i.e.*, in the shape of the shell, and certain features of the soft parts (See key p. 568). Furthermore we find in *Anodontites* an extreme variability in the shape of the shell, from rounded and subovate, to subtrapezoidal and elongated. The number of species is very great, and it is hard to arrange them. Simpson (1914) distinguishes three sections.

1. Section *Anodontites* (*sensu stricto*). Shell rounded to elliptical; posterior ridge low or wanting.

2. Section *Styganodon* Von Martens (1900). Shell subrhomboidal, with a thick, dark, rather rough, sombre-colored epidermis, which is sometimes faintly rayed; naere lurid, shaded green.

3. Section *Virgula* Simpson (1900). Shell subsolid to solid, moderately inflated, greatly elongated, straight or falcate, rounded in front, sharply pointed at the posterior base, where the high, sharply defined posterior ridge ends, and above which it is somewhat obliquely truncated; beaks not high; epidermis green to olive; naere brilliant, bluish or purplish, iridescent, rayed with very fine, indistinct ridges; posterior end with a slight sinus.

It is seen at a glance that these three sections are not uniformly well defined. *Virgula*, indeed, is sharply separated from the rest. *Styganodon* is well characterized by the epidermis; but unfortunately the type of the genus (*Anodontites crispata*) undoubtedly belongs to *Styganodon*, having an epidermis (thick, dark, rough, sombre-colored) which represents an extreme development of the *Styganodon*-structure; in other characters also, *A. crispata* is closely allied to *A. tenebricosa*,<sup>27</sup> the type of *Styganodon*.

It is clear that, on the one hand, *Anodontites* (*sensu strictiore*) must be used for *crispata*, and, on the other hand, that *Styganodon* is a synonym of this, the type of the latter being closely related to *crispata*. This necessitates a re-arrangement of the sections, and a revision of their nomenclature. Although I have good material representing the genus, it is impossible for me to attempt a final classification, and the one given below is primarily adapted to the material at hand. An attempt is made to preserve Simpson's groups as far as possible.

*Geographical distribution:* The genus is widely distributed over South America east of the Cordilleras from Patagonia to the Caribbean Sea, being found also in the northern parts, where *Diplodon* and the *Hyriinae* in general are rare, or absent. West of the Cordilleras it is generally missing, but it has been reported from that side in Ecuador (the fact, however, requires confirmation). In addition the genus has extended its range northward into Central America and Mexico, where it is found in both the Pacific and Atlantic drainages.

#### KEY TO THE GROUPS OF ANODONTITES.

- a<sub>1</sub>. Shell not greatly elongated, nor pointed behind, without sharp posterior ridge. Posterior retractor-scar connected with adductor-scar.....Subgenus *Anodontites* s. s.
- b<sub>1</sub>. Epidermis dull, densely wrinkled.
  - c<sub>1</sub>. Shell more or less elongated, but not distinctly oblique and subcircular.
    - d<sub>1</sub>. Shell subtrapezoidal, somewhat elongated. Lower margin straight or concave.
      - Group of *A. crispata*.
    - d<sub>2</sub>. Shell subovate or subelliptical, rather short. Lower margin convex.
      - Group of *A. obtusa*.
  - c<sub>2</sub>. Shell distinctly oblique, short and high, nearly subcircular.....Group of *A. trapezca*.
- b<sub>2</sub>. Epidermis more or less shining, wrinkles only partially developed or absent. Shell straight or oblique, often distinctly so.
  - c<sub>1</sub>. Shell not very oblique; straight, rather elongated, more or less pointed behind. Prismatic border narrow, of equal width.....Group of *A. trigona*.
  - c<sub>2</sub>. Shell strongly oblique, not much elongated, not, or very little, pointed behind.
    - d<sub>1</sub>. Shell subovate or subrotund. Prismatic border wide, width unequal.
      - Group of *A. patagonica*.

<sup>27</sup> Another species, *A. napoënsis*, allied to *crispata*, has been placed in *Styganodon* by Haas (1916, pp. 32, 55).

*d*<sub>2</sub>. Shell subovate or subtrapezoidal. Prismatic border narrow and of equal width.

Group of *A. trapesialis*.

*a*<sub>2</sub>. Shell greatly elongated, sharply pointed behind, with a sharp posterior ridge. Posterior retractor-scar completely separated from adductor-scar. Epidermis not shining, covered with fine wrinkles.

Subgenus *Lamproscapha*.

#### Subgenus ANODONTITES *s. s.*

*Anodontites s. s.* + *Styganodon* VON MARTENS, SIMPSON, 1914, pp. 1403, 1448.

Shell of various shapes, but not greatly elongated or pointed behind, without sharp posterior ridge. Posterior retractor-scar connected with adductor-scar.

#### 1. Group of *Anodontites crispata*.

Group of *A. crispatus* SIMPSON, 1914, p. 1414 (*pars*) + Section *Styganodon*, group of *A. tenebricosus*, SIMPSON, *ibid.*, p. 1448.

Shell not, or very little, oblique, subtrapezoidal, rather elongated, with the lower margin straight or more or less concave (sinuated). Epidermis dull, dark, not rayed, not smooth, but strongly and densely sculptured all over by concentric or radial, or irregular wrinkles. Prismatic border narrow or wider, of nearly equal width.

The most essential feature of this group is in the texture of the epidermis, and its somber color. The naere also is peculiar, being dull and lurid.

These forms greatly resemble certain African species of *Spatha*, subgenus *Aspatharia*, and I am strongly inclined to think that of all South American types of *Mutelinæ* these show the closest affinities to that African group. In *A. crispata* occasionally a single dorsal muscle-scar is present, which also agrees with the condition regularly seen in *Spatha*.

Three species belonging here are known to me in nature. They may be distinguished as follows:

- a*<sub>1</sub>. Wrinkles of epidermis arranged concentrically and radially, the radial tendency prevailing. Prismatic border moderate. . . . . *A. crispata*.
- a*<sub>2</sub>. Wrinkles of epidermis with concentric tendency prevailing, radial arrangement obscure.
  - b*<sub>1</sub>. Shell comparatively shorter and higher, beaks more median in position. . . . . *A. tenebricosus*.
  - b*<sub>2</sub>. Shell comparatively longer and lower, beaks more anterior in position. . . . . *A. clessini*.

#### 48. ANODONTITES CRISPATA<sup>28</sup> Bruguière (1792).

*Shells*: Plate XL, figs. 7, 8; Plate XLI, figs. 2, 3.

*Anodontites crispata* BRUGUIÈRE, Journ. Hist. Nat. Paris, I, 1792, p. 131; SIMPSON, 1914, p. 1415.

*Anodon reticulatus* SOWERBY, XVII, 1867, Pl. 10, fig. 27.

<sup>28</sup> Bruguière uses *Anodontites* as *feminini* generis, and this should not be changed.

*Glabaris crispatus* SIMPSON, 1900, p. 919.

*Type-locality*.—South America.

*Other Localities*.—Cayenne (Lea, Syn., 1870, p. 106); Amazon River (Sowerby, *reticulatus*).

*New Locality*.—Rio de la Paila, Paila, U. S. of Colombia (C. H. Eigenmann coll., 1912). About twenty specimens, ten of them with soft parts, males and females. (The Rio de la Paila is a tributary of the upper Rio Cauca of the Rio Magdalena-drainage).

*Distribution*.—Simpson says that this species is widely distributed in tropical South America, though but few exact localities are known.

*Characters of the Shell*.—Of medium size (maximum length 67 mm.), moderately thick, rather thin when young. Outline elongated subtrapezoidal, or sub-elliptical. Height 52 to 61 pr. et. of the length. Valves practically closed, or very little gaping in front. Dorsal margin straight, or prevalently very gently curved behind the beaks, descending in front of the beaks, and passing gradually into the anterior margin. Posteriorly it forms a blunt angle with the posterior margin, or passes into it in a curve. Posterior margin curved, obliquely descending in its upper part, becoming gradually steeper, and sometimes nearly vertical at the posterior end, which is blunt and rounded, but bends rather suddenly into the lower margin. The posterior end is thus very little elevated above the base-line, often practically at its level. Lower margin straight for a considerable distance, often even slightly concave in the middle, gently sloping upward toward the front and curving up into the anterior margin. This ascending part, and the descending anterior upper margin, make the anterior end of the shell narrower, but the whole shell does not appear very oblique. The highest part of the shell is in the posterior section.

Valves moderately convex, rather flattened upon the sides, and sometimes even with a shallow depression corresponding to the emargination of the lower margin. Posterior ridge broad and rounded, indistinct, but the greatest diameter of the shell (31 to 38 pr. et. of length) is situated upon it, so that the shell is more swollen posteriorly than anteriorly. Posterior slope slightly compressed, sometimes with a very faint radial groove. Beaks not swollen and not elevated above the hinge-line, located at 27 to 33 pr. et. of the length. Lunula indistinct or narrow, not very long.

Epidermis finely wrinkled all over, the wrinkles partly concentric, but prevailingly arranged in a radial pattern. Concentric and lamellar wrinkles are found chiefly near the margins. Upon the disk, the pattern varies in the anterior and



posterior section of the shell. Anteriorly there are short, concentric wrinkles, arranged in scalariform, radial bands. Posteriorly the wrinkles are rather irregularly radial, assuming generally an oblique direction, forming radial bands of loops or V-shaped festoons, often anastomosing, and more or less reticular ("like dried paint"). In the middle of the shell the two types of sculpture pass into each other: the short, subconcentric, scalariform wrinkles become rather suddenly V-shaped, and assume the oblique or radial direction. On the posterior slope and near the lower margin, the wrinkled sculpture is more or less obscured by sublamellar concentric striae. Color of epidermis, in very young specimens, yellowish; later it becomes brownish olive or dark greenish to blackish, generally more brownish toward the beaks, and more blackish toward the margins. Sometimes (in strong transmitted light) there are dark color rays upon the posterior slope.

Hinge-line nearly straight or gently convex posteriorly, descending anteriorly, a little irregular just in front of the beaks. Ligamental sinus moderate, triangular, wider than deep, its anterior margin slightly oblique to the hinge-line. Nacre blueish white, grayish white, lurid, often showing brownish or greenish discoloration. Prismatic border rather narrow, subequal in width, of grayish color.

Cavity of shell and beaks shallow. Anterior adductor-sear well marked, impressed, irregularly elliptical. Anterior retractor-sear only partially separated from adductor-sear, connected with it narrowly or more broadly, and very variable in this respect. Anterior protractor-sear separated from adductor-sear. Posterior adductor-sear less impressed, rounded or subovate, posterior retractor-sear forming an upper process of it. Dorsal sears generally absent, but in a few cases there is an indistinct single one. Pallial line distinct, simple, subparallel to the margin.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
1. . . .	♂	24.5 mm.	15 mm. = 61 pr. ct. of L.	8.5 mm. = 35 pr. ct. of L.	at 7 mm. = 29 pr. ct. of L.	
	?	37 "	19.5 " = 53 "	11.5 " = 31 "	10 " = 27 "	Pl. XLI, fig. 3.
2. . . .	♀	45 "	27.5 " = 61 "	17 " = 38 "	15 " = 33 "	
5. . . .	♀	56 "	29 " = 52 "	19.5 " = 35 "	15 " = 27 "	
10. . . .	♀	63.5 "	35 " = 55 "	22 " = 35 "	18 " = 28 "	Pl. XLI, fig. 8.
	?	67 "	35 " = 52 "	22 " = 33 "	19 " = 28 "	Pl. XLI, fig. 2.
Simpson . . . .		53 "	27.5 " = 52 "	17 " = 32 "		

*Remarks.*—I have no doubt that my specimens represent *A. crispata*. They agree fairly well with Sowerby's figure of *Anodon reticulatus*, and very well with Simpson's description. But there are several closely allied, if not identical, species, chiefly *A. napoënsis* Lea (Obs. XII, 1869, Pl. 53, fig. 137, and Germain, 1910, p. C 64, Pl. 2, figs. 3, 4) from Rio Napo (tributary to the upper Amazon in Ecuador) and Rio Unuyaçu (tributary to Napo). This species differs chiefly in the posterior

end of the shell, which is more elevated above the base-line, and in the more curved ventral margin. The sculpture of this species undoubtedly is similar, but the details have not been described.

Simpson says that this species is very variable in sculpture. However, I find that my specimens (twenty at hand) are rather uniform in this respect. Only in the youngest specimen is the subradial sculpture of the posterior part not so well developed; but in the second (37 mm. long) it is distinctly seen.

There is a good deal of variation in the shape of the posterior end, and the posterior margin may be more oblique or may be more vertical in its lower part. Very often the nearly vertical truncation of the posterior end produces the appearance of a biangulation, chiefly when the faint groove of the posterior slope is visible.

*Anatomy*.—Soft parts of six males and four barren females at hand for study. Anal opening separated from the branchial by a mantle connection, open and nowhere closed, its inner edge smooth or nearly so. Branchial opening with fine papillae. Palpi longer than high, lower margins convex, posteriorly truncated, the truncation forming the short posterior margins, which are connected at base only.

Gills of medium width, the inner the wider anteriorly, its anterior end immediately behind the palpi, and attached to the whole interval between the palpi and the anterior end of the outer gill. The latter at the highest point of the mantle-attachment-line. Inner lamina of inner gill entirely connected with abdominal sac.

Gills with well developed septa. In the non-marsupial gills the septa are irregularly alternating, stronger and weaker. In the female the inner gill is *marsupial* for nearly its whole length, with stronger and more uniform, but not more crowded, septa. The septa possess the usual swelling, forming vertical ridges projecting into the lumen of the water-tubes, dividing the latter into an inner compartment (ovisac), and an outer (secondary water-tube).

49. *ANODONTITES TENEBRICOSA* (Lea) (1834).

*Anodonta tenebricosa* LEA, Obs., I, 1834, Pl. 12, fig. 36; D'ORBIGNY, 1843, p. 616.

*Anodon tenebrosa* SOWERBY, XVII, 1867, Pl. 13, fig. 43.

*Anodon tenebricosa* SOWERBY, XVII, 1870, Pl. 31, fig. 123.

*Anodonta tenebricosta* CORSI, 1901, p. 457, fig. 58.

*Glabaris tenebricosa* VON IHERING, 1893, p. 61; NEHRING, 1893, p. 163; SIMPSON, 1900, p. 930.

*Anodontites tenebricosus* SIMPSON, 1914, p. 1448.

*Anodontites (Styganodon) tenebricosus* HAAS, 1916, pp. 35, 57.

*Type-locality*.—Rio Paraná.

*Other Localities*.—Rio San José and Arroyo del Rosario, Uruguay (D'Orbigny) (tributaries to La Plata in the Banda Oriental); Rio de la Plata, Buenos Aires, Argentina (D'Orbigny); Buenos Aires (Haas); Rio Uruguay, Salto Oriental, Uruguay (Haas); Rio Piracicaba, Piracicaba, São Paulo, Brazil (Von Ihering) (Nehring).

*New Localities*.—Pond along banks of Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). One complete specimen and one left valve. Rio de la Plata, San Isidro, 20 km. North of Buenos Aires, Argentina (A. Windhausen coll., January, 1917). One female with soft parts.

*Distribution*.—From the region of Buenos Aires in the La Plata system and its tributaries in Uruguay (smaller streams of the Banda Oriental and Rio Uruguay-system) up the Paraná River to its headwaters in São Paulo, Brazil.

Simpson gives a much larger range, adding even Ecuador and Peru, but I do not know on what authority.

This species is well known and has been well described. Its chief characters are its shape, which, although elongated-subtrapezoidal, is rather short and high in comparison with the related species. The prismatic border of the shell, chiefly in old shells, is remarkably wide, but subequal in width, not suddenly changing anywhere.

The character of the epidermis has been given as concentrically lamellose. This is correct, and the fine, crowded, concentric lamellæ are very obvious. However, closer investigation shows that between these lamellæ are additional, more irregular wrinkles, which produce upon the posterior part of the shell a reticulated (anastomosing) sculpture, and more anteriorly these wrinkles may be even radial. But they exist only between the concentric lamellæ, and thus they are very short and largely obscured by the concentric sculpture. This difference of sculpture from that of *A. crispata* is very striking. Otherwise these two species have many features in common.

#### MEASUREMENTS.

	Sex.	Length.	Height.	Diameter.	Beaks.
S. Isabel . . . . .	?	57 mm.	33 mm. = 58 pr. et. of L.	17 mm. = 29 pr. et. of L.	at 18 mm. = 32 pr. et. of L.
S. Isidro . . . . .	♀	92 "	51 " = 59 "	32 " = 35 "	27 " = 29 "

According to Von Ihering's measurements, the height is 53 pr. et. and the diameter 34 pr. et. of length. According to Nehring's measurements the height is 48 to 55 pr. et., the diameter 30 to 33 pr. et. Thus specimens from the upper

Paraná-drainage seem to be not so high, more elongated than those from the lower part of the system. In Lea's original specimen (according to figure and measurements given by Simpson), the height is 55 pr. et., the diameter 45 pr. et. of length. In another specimen measured by Simpson, the height is 60 pr. et., the diameter 38 pr. et. D'Orbigny's measurements give for height 58 pr. et. and for diameter 37 pr. et. These latter figures agree very well with mine, and it should be noted that the larger specimens generally give a proportionally greater diameter.

*Anatomy.*—The soft parts of one barren female are at hand for examination.

Practically identical with the preceding species. The gills, in the present specimen, appear comparatively narrow. The structure of the *marsupium* (inner gill) is typical. The swellings of the septa are very distinct, and are situated closer to the outer lamina (primary limb).

#### 50. ANODONTITES CLESSINI (Fischer) (1890).

*Shells:* Plate XLI, fig. 4; Plate XLII, figs. 1, 2. *Anatomy of gills:* Plate XLVII, fig. 4.

*Myctopus plicatus* CLESSIN, Malakozoöl. Blätt., LI, 1882, p. 190, Pl. 4, fig. 7 (*nomen praeoccupatum*).

*Myctopus clessini* FISCHER, Journ. de Conchyliol., XXXVIII, 1890, p. 8, footnote. *Glabaris nehringi* VON IHERING, 1893, p. 60; NEHRING, 1893, p. 163; VON IHERING, 1910, p. 139.

*Glabaris clessini* SIMPSON, 1900, p. 930.

*Anodontites clessini* SIMPSON, 1914, p. 1450.

*Type-locality:* ?

*Other Localities.*—Rio Sta. Maria, Rio Grande do Sul, Brazil (Von Ihering) (tributary to Ibicuihy and Uruguay); Rio Piracicaba, Piracicaba, São Paulo, Brazil (Von Ihering); Rio Piracicaba Mirim, Piracicaba, São Paulo, Brazil (Nehring); Rio Paraguassú, Bahia, Brazil (Von Ihering, 1910).

*New Locality.*—Rio Vaccahy Mirim, Santa Maria (da Bocca do Monte), Rio Grande do Sul, Brazil (J. D. Haseman coll., January 29, 1909). Twelve specimens, all with soft parts, males and females.

*Distribution.*—Positively known from the Uruguay drainage and the headwaters of the Paraná. In addition, it has crossed over into certain coastal streams in Brazil. Our locality in Rio Vaccahy Mirim belongs to the Jacuihy-Guabyba-system, but is close to Von Ihering's record from the Uruguay drainage, but on the other side of the divide. This species has been found also in the Rio Paraguassú in Bahia, well to the North, and separated from the rest of the range in the upper Paraná (Piracicaba). But probably some kind of connection will be found.

This species may be regarded as an elongated and narrow *tenebricosa*. In consequence of the general elongation, the posterior margin forms a more obtuse angle with the upper margin, and the posterior end is not subtruncated, but more evenly and narrowly rounded. Young specimens are almost regularly long-elliptical. The prismatic zone is comparatively narrow. The ligamental sinus is triangular, wider than deep, and its anterior margin forms an obtuse angle with the hinge-line (being directed obliquely backwards), or is almost vertical. (In *A. tenebricosa* this sinus is about as deep as wide, its anterior margin is nearly vertical and curved gently forwards, so that the lower point, which is quite sharp, is directed obliquely forward).

In all other characters the two species resemble each other, and this is pre-eminently true of the sculpture of the epidermis.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
1..	♂	31 mm.	16 mm. = 52 pr. et. of L.	8.5 mm. = 24 pr. et. of L.	10 mm. = 32 pr. et. of L.	
4..	♂	45 "	22 " = 49 "	13 " = 29 "	12 " = 26 "	
8..	♀	61 "	27 " = 44 "	19 " = 31 "	17 " = 28 "	
11..	♀	68 "	34 " = 50 "	20 " = 29 "	19 " = 28 "	Pl. XLII, fig. 2.
10..	♀	69 "	31 " = 45 "	23 " = 33 "	18 " = 26 "	Pl. XLII, fig. 4;
12..	♂	70 "	32 " = 46 "	21 " = 30 "	18 " = 26 "	Pl. XLII, fig. 1.

According to Von Ihering, the height is from 43 to 51 pr. et., the diameter from 22 to 33 pr. et. of length, the beaks are at 24 to 31 pr. et. According to Nehring, the height is 41 to 43 pr. et., the diameter 20 to 25 pr. et. In *A. tenebricosa*, the figures for the height are 55 to 60 pr. et. (rarely below this); for the diameter 29 to 45 pr. et. and for the beaks 29 to 34 pr. et.

*Remarks.*—The greater length of the shell is brought out by these figures, and also the lesser obesity and more anterior position of the beaks, which results from it. It is also seen in my specimens that the elongation is not so great in younger specimens, and in the latter the measurements approach those of *tenebricosa*, or even fall within the range of variation of it. It is possible that the two species actually intergrade, a condition which has been hinted at by Nehring (p. 164) to exist in the Rio Piracicaba.

*Anatomy.*—The soft parts of seven males and five barren females have been investigated.

Color of soft parts whitish; inner edge of anal and branchial openings black, the black color running forwards from the branchial for a certain distance.

Anal opening entirely open, its inner edge practically smooth, separated from the branchial opening by a connection of the mantle-margins. Inner edge

of branchial opening with distinct, but small papillæ. Palpi rather small, semi-circular, shortly truncate posteriorly, thus forming posterior margins, which are not connected.

Gills (Pl. XLVII, figs. 4*a*, *b*) long and narrow, the inner considerably wider than the outer, chiefly anteriorly. Anterior end of inner gill immediately behind the palpi. Inner lamina of inner gill entirely connected with abdominal sac. Septa well developed, those of the non-marsupial gills alternately somewhat stronger and weaker, best seen in the outer gill of the female (Pl. XLVII, fig. 4*b*). Inner gill of female *marsupial* for nearly its whole length, with more uniform, thicker, but not more crowded septa, which have the usual swellings near their contact with the outer lamina.

2. *Group of Anodontites obtusa.*

Simpson, 1914, p. 1453.

Shell not very oblique, subovate or subelliptical, rather short, lower margin convex. Epidermis dull, greenish, often with rays, concentrically lamellarly wrinkled. Prismatic border narrow.

The few forms belonging here are closely allied to the first group, and have indeed been placed in the section of *Stygianodon* by Simpson. They are shorter, higher than those of the *crispata*-group, with more inflated beaks, and have an unusual development of color-rays. The sculpture of the epidermis is much like that of *tenebricosa* and *classini*, and consists of close, sublamellar, concentric wrinkles, here and there subreticulated.

51. ANODONTITES OBTUSA (Spix) (1827).

*Anodon obtusum* SPIX, 1827, Pl. 22, fig. 3; WAGNER, Ibid, p. 30.

*Anodon lituratum* SPIX, Ibid, Pl. 22, fig. 4.

*Anodonta obtusa* and *liturata* HUPÉ, 1857, pp. 86, 87, Pl. 17, fig. 4.

*Anodon obtusus* SOWERBY, XVII, 1867, Pl. 12, fig. 39.

*Anodon liturata* SOWERBY, Ibid, 1868, Pl. 20, fig. 78.

*Anodonta obtusa* VON IHERING, 1890, p. 159.

*Glabaris obtusus* and *lituratus* SIMPSON, 1900, p. 931.

*Anodonta (Glabaris) obtusa* GERMAIN, 1910, p. 63, Pl. 3, figs. 14, 15.

*Anodontites obtusus* and *lituratus* SIMPSON, 1914, pp. 1453, 1454.

*Type-locality*.—Rio Paraguassú, Bahia, Brazil.

*Other Records*.—Rio Paraguassú (Von Ihering, 1910, p. 139); Rio São Francisco, Villa Nova, Sergipe, Brazil (Von Ihering); Rio São Francisco, Joazeiro, Bahia, Brazil (Von Ihering); Rio das Velhas, Minas Geraes, Brazil (Von Ihering) (upper

S. Francisco-drainage); Bodegas, and Rio Daule, Ecuador (Germain) (Pacific-drainage, near Guayaquil).

*New Locality*.—Lagoa Sacho Grande, Cidade da Barra, Bahia, Brazil (J. D. Haseman coll., December 24, 1907). One young specimen. (S. Francisco-drainage).

Another, larger specimen is in the Carnegie Museum, from the Holland Collection, labeled "Brazil."

*Distribution*.—Known from the drainages of Rio Paraguassú and São Francisco. Von Ihering gives a possible variety, similar to the var. *hohenackeri*, from Rio Mucury, Bahia (southern part) (1890, p. 161), and another variety (*juparana*, 1910, p. 131) from Lagoa Juparana of Rio Doce, Espírito Santo).<sup>29</sup> The form is not known from the basin of the Amazon. So much more astonishing is Germain's record of this species from the Pacific slope in Ecuador. I cannot discover any differences in these specimens, but attention should be called in this connection to *A. aff. pastasanus* of Haas (1916, pp. 34, 56, Pl. 2, fig. 1) which comes from the identical localities (Rio Daule and Bodegas in Ecuador). The latter, however, is more elongated than Germain's figure of *obtusa*, and cannot be the same.

Simpson also cites Paraguay, but I do not know on what authority.

After what Wagner and Von Ihering have said, it is perfectly clear that *liturata* is the young stage of *obtusa*, and my larger specimen shows, near the beaks, the juvenile character of broken and oblique rays. Hupé says that *liturata* is less swollen than *obtusa*, while Simpson (1914, p. 1454) states the opposite, that it is more inflated (possibly slip of the pen). Of my two specimens it is the smaller one, with *liturata*-color-markings, which is the more swollen.

#### MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
Barra . . . . .	36 mm.	24 mm. = 67 pr. et. of L.	17 mm. = 47 pr. et. of L.	at 12 mm. = 33 pr. et. of L.
Brazil . . . . .	47 "	32 " = 68 "	19 " = 40 "	17 " = 36 "
Spix' type . .	53 "	35 " = 66 "	25 " = 47 "	

### 3. GROUP OF ANODONTITES TRAPEZEA.

Shell subcircular, but distinctly oblique, short and high. Epidermis dull, densely, concentrically, lamellarly wrinkled. Prismatic border moderate, or narrow, of nearly equal width.

The subcircular shape and the dull, cloth-like epidermis are found in no other group combined.

<sup>29</sup> In 1910 (p. 131) he says that specimens from Rio Mucury are *juparana*.

## 52. ANODONTITES TRAPEZEA (Spix) (1827).

*Anodon rotundum* and *trapezeum* SPIX AND WAGNER, 1827, p. 28, Pl. 20, figs. 1-4.  
*Anodonta rotunda* and *trapezea* VON IHERING, 1890, pp. 142, 145, Pl. 9, figs. 5, 6.  
*Anodonta cailliaudi* LEA, Obs.,-X, 1863, Pl. 45, fig. 297.  
*Anodon cailliaudi* SOWERBY, XVII, 1867, Pl. 12, fig. 38.  
*Glabaris rotunda* VON IHERING, 1893, p. 59; SIMPSON, 1900, p. 918.  
*Glabaris trapezea* VON IHERING, 1893, p. 57; NEHRING, 1893, p. 163; VON IHERING, 1910, p. 138.  
*Anodontites rotundus* SIMPSON, 1914, p. 1410.

D'Orbigny first recognized the identity of *trapezea* and *rotunda*, and selected the first name. Although the specimens from Corrientes, to which he applied this name, may not have been the typical *trapezea*, but a variety or even a species (*spixi* D'Orbigny, 1835), his selection of *trapezea* in preference to *rotunda* should be accepted.

*Type-locality*.—Rio Solimões (middle Amazon) Brazil.

*Other Localities*.—Rio São Francisco, Villa Nova, Sergipe, Brazil (Von Ihering, *trapezea*); São Paulo, Brazil (Wagner, *rotunda*); Rio Piracicaba, Piracicaba, São Paulo, Brazil (Von Ihering, *trapezea*).

This species, partly as *rotunda*, partly as *trapezea*, has been reported (D'Orbigny, Lea, Von Ihering) from the lower Rio Paraná (near Corrientes). However, the *A. trapezea* of D'Orbigny is believed to be a different form or variety (*A. spixi* D'Orbigny). It is surely allied to *trapezea*.

*New Localities*.—Lagoa de Sacho Grande, Cidade da Barra, Bahia, Brazil (J. D. Haseman coll., December 24, 1907). Six complete shells and four odd (left) valves. Lagoa de Sacho Pequeno, Cidade da Barra, Bahia, Brazil (J. D. Haseman coll., December 24, 1907). Three specimens, one a male with soft parts. Rio Grande, Barreiras, Bahia, Brazil (J. D. Haseman coll., January 4, 1908). Three males with soft parts. Rio São Francisco, Joazeiro, Bahia, Brazil (J. D. Haseman coll., February 28, 1908). One odd (left) valve.

All these localities are in the drainage of the Rio São Francisco.

*Distribution*.—The presence of this species in the system of Rio São Francisco is established. Since Von Ihering has also cited it as *trapezea* from the upper Paraná (Piracicaba) in São Paulo, it must belong to both systems. Farther down the Paraná (Corrientes, Argentina) similar shells are present, but apparently slightly different from the type. The original locality is in the Amazon-drainage, but it has not subsequently been found there.

*Characters of the Shell*.—Shell of moderate size (maximum length 75 mm.),



rather thin when young, slightly more solid when older, but never of considerable thickness. Outline subcircular, but a little irregular and variable, and distinctly oblique. Height 80 to 93 pr. et. of the length. Valves not gaping. Dorsal margin nearly straight. Posterior and anterior margins uniting with the dorsal in blunt angles. Posterior margin obliquely descending, first straight, then curved, and passing in a rather regular curve in the posterior part of the lower margin, without any trace of a posterior point. Lower margin ascending forward more strongly, and curving up into the anterior margin, so that the anterior part of the shell appears somewhat narrower than the posterior part, thus producing the obliquity.

Valves inflated, diameter 49 to 56 pr. et. of the length. Beaks somewhat swollen and inflated, elevated above the hinge-line and incurved, their tips immediately above the hinge-line in the young, a little higher in older shells. Location of beaks at 33 to 44 pr. et. of the length. Outer surface of shell rather regularly convex, but anterior and posterior slopes somewhat compressed. Posterior ridge quite indistinct.

This species is remarkable for the presence of *beak-sculpture*, which is generally absent in this subfamily. However, I think that this sculpture is not genetically connected with that of other *Naiades*, but probably is independently developed. Quite a number of my younger specimens show it. The very tip of the beak appears as a small tubercle, and is succeeded by three to five concentric bars, which follow the growth-lines, and are low and rounded, but perfectly distinct in the middle, disappearing anteriorly and posteriorly. These bars are restricted to and crowded together at the extremity of the beaks, and disappear at a short distance (3 to 4 mm.) from them.

Epidermis with fine and crowded, concentric, somewhat anastomosing lines, which become lamellarly elevated toward the margins, and in well preserved shells, chiefly young ones, they have this character all over the shell. In addition there may be fine and faint radial striae, but there are no scalariform stripes. In old and partly worn shells the surface becomes rather smooth, but remains always dull, and is not shining. Color of epidermis from dark green to yellowish brown. The normal color in young specimens seems to be lighter or darker green, sometimes with indistinct dark green rays (seen only in transmitted light). In older specimens the color becomes greenish brown to light brown, due to partial abrasion of the epidermis. There are always two more or less distinct dark green or blackish rays upon the posterior slope, often accompanied by two lighter, yellowish rays. Larger specimens may have a few dark brown growth-rests.

Hinge-line practically straight in young shells; in older shells it curves gently down under the beaks, and up again at the anterior end, and the posterior end curves gently down, thus forming a slight S-curve. Ligamental sinus triangular, not deeper than wide, varying with age (shallower in young shells), its anterior margin running obliquely backward in the young, and vertically in older individuals; its lower point may be sometimes directed forwards.

Cavity of shell and of the beaks rather deep, corresponding to the obesity of the shell. Nacre white; in young shells blueish white, in older shells somewhat inclining to cream-color, always extremely glossy, silvery, and iridescent toward the margins, with fine, straight, and irregular radiating lines. Along the margin there is a rather narrow naereless (prismatic) zone, relatively wider in young specimens. This zone is subconcentric with the shell-margin, widest in the middle, gradually narrowing towards the ends, but nowhere suddenly or markedly changing its width.

Anterior adductor-scar and anterior retractor-scar united, not deep, irregularly ovate or elliptical; anterior protractor-scar connected with adductor-scar, or, in old specimens, more or less (sometimes distinctly) separated. Posterior adductor-scar faint, subovate, the posterior retractor-scar forming an upper projection thereof. No dorsal scars. Pallial line subconcentric to margin.

## MEASUREMENTS.

Location.	No.	Sex.	Length.		Height.		Diameter.		Beaks.
Sacho Grande . . . . .	<i>a</i>	?	30	mm.	24	mm. = 80 pr. ct. of L.	15	mm. = 50 pr. ct. of L.	at 13 mm. = 43 pr. ct. of L.
Sacho Pequeno . . . . .		♂	41	"	34	" = 83 "	21	" = 51 "	18 " = 44 "
Barreiras . . . . .	1	♂	47	"	42	" = 89 "	24	" = 51 "	18 " = 38 "
Do. . . . .	3	♂	54	"	47	" = 87 "	27	" = 50 "	20 " = 37 "
Sacho Grande . . . . .	<i>b</i>	?	58	"	48	" = 83 "	30	" = 52 "	24 " = 41 "
Do. . . . .		?	68	"	63	" = 93 "	38	" = 56 "	30 " = 44 "
Sacho Pequeno . . . . .	<i>c</i>	?	72.5	"	61.5	" = 85 "	38	" = 52 "	24 " = 33 "
<i>trapezca</i> , type . . . . .			63	"	52	" = 84 "	31	" = 49 "	(Von Ihering)
<i>rotunda</i> , type . . . . .			42	"	36	" = 86 "	22	" = 52 "	Do.
<i>trapezca</i> (Piracicaba) . . . . .			60	"	49	" = 82 "	33	" = 55 "	Do.
<i>rotunda</i> (Simpson) . . . . .			75	"	64	" = 85 "	38	" = 51 "	

The variety (or species) *spixi* D'Orbigny from the lower Paraná at Corrientes grows larger, reaching the length of 81 mm. according to Von Ihering, and of 90 mm. according to D'Orbigny.

*Remarks.*—This shell is easily recognized by the general shape and proportions, by the rather narrow prismatic border, and by the dull, greenish color of the epidermis. That *trapezca* and *rotunda* are only the old and the young stages of the same species, is conclusively shown by our material, chiefly by the sets from Cidade da Barra. The old specimens have the beaks a little elevated above the hinge-line, and the hinge-line is gently curved; while the young specimens have the point

of the beaks immediately above the hinge-line, and have the latter straight. Specimens of intermediate size intergrade in these characters.

*Anatomy.*—The soft parts at hand are not in good condition. However, the structure of the gills can be made out, and according to the alternation of stronger and weaker septa, all four specimens at hand are males.

In other respects the usual structure of the genus is seen. Anal opening entirely open, separated from the branchial by a mantle-connection. Branchial opening with distinct, but small papillæ. Palpi small, subcircular, with a short truncation at the posterior end; the posterior margins not connected. Inner lamina of inner gill entirely connected with abdominal sac.

#### 4. GROUP OF *Anodontites trigona*.

Simpson, 1914, p. 1441.

Shell not very oblique, rather elongated, subelliptical, or subovate, narrowly rounded, or somewhat pointed behind. Epidermis more or less shining, and not uniformly and densely covered with wrinkles, although such are present here and there. Prismatic border narrow, of nearly equal width.

This group is poorly defined. Its chief character is the rather elongated shell, somewhat pointed behind, or narrowly rounded, and not distinctly oblique. The comparatively smooth epidermis is another noticeable feature, but still there are species, which have sublamellar, concentric striae, at least in parts of the shell. The color of the epidermis is not so sombre and dull as in the preceding groups. The narrow prismatic border seems to be constant.

#### 53. ANODONTITES TRIGONA (Spix) (1827).

*Anodon trigonum* SPIX & WAGNER, 1827, p. 29. Pl. 22, fig. 2.

*Glabaris trigonus* SIMPSON, 1900, p. 928.

*Anodontites trigonus* SIMPSON, 1914, p. 1441.

*Anodon moretonianus* SOWERBY, XVII, 1867, Pl. 9, fig. 20.

Doubtfully synonymous:

*Anodon georginae* GRIFFITH, 1834, p. 595 (index), Pl. 19, fig. 3.

*A. moretonianus* Sowerby undoubtedly is this species. Simpson (1914, p. 1431) is mistaken in placing it with *A. trapesialis*. Sowerby's *moretonianus* is not *A. mortoniana* of Lea.

*A. georginae* Griffith, from "rivers of Paraguay," also seems to be this species. The figure given *l.c.* is shorter and higher, but the characteristic shape and the radial ribs (although too much emphasized) well agree with it. It is also from a region, where *trigona* is known to occur. For this species, Simpson (1900, p. 927; 1914, p. 1440) creates a separate group.

Simpson makes *Anodonta castelnaudi* Hupé a synonym of *trigona*, but I do not think that this is correct. *A. castelnaudi* lacks the chief characteristic features of *trigona*: the pointed posterior end and the rib upon the posterior slope.

*Type-locality*.—Rivers of the "province Rio Negro." There is now no such province in Brazil, from which country the collections of Spix came.

*Other Localities*.—Amazonas and Bolivia (Von Ihering, 1893, p. 120); Rio Xingu, Pará, Brazil (tributary to lower Amazon) (Von Ihering, 1910, p. 137); Tributaries of Amazon in Bolivia (territory of the Chiquitos and Moxos) (D'Orbigny); Rio Estacamento, Peru (Haas, 1916); Rio Paraguay, San Luis de Caceres, Matto Grosso, Brazil (Von Ihering, 1915, p. 13); Rio Batel and Rio Paraná, Corrientes, Argentina (D'Orbigny).

*New Localities*.—Swamp of Lambaré, Asunción, Paraguay (J. D. Haseman coll., March 31, 1909). One right valve. Headwaters of Rio Paraguay, Santa Rita, Matto Grosso, Brazil (J. D. Haseman coll., June 12, 1909). Two specimens, male and female, with soft parts. Rio Limay, Patagonia, Argentina (W. Israël donor). One specimen.

*Distribution*.—According to Von Ihering (1890): "Everywhere in the Amazonas region, but also in the La Plata up to Corrientes." Simpson gives: Brazil, Ecuador, Peru, Bolivia. The species undoubtedly has a wide distribution, both in the Amazon and the Paraguay-Paraná drainages, but is apparently missing in the upper Paraná. The new locality in Rio Limay in Patagonia (Rio Negro-drainage) considerably extends the southward range.

*Description of Shell*.—Shell rather thick and solid. Outline elongated-ovate, pointed behind, lower margin convex, forming a bluntly projecting angle about its middle. Height 59 to 61 pr. et. of length according to my specimens (in D'Orbigny's the height is only 54 pr. et.). Valves not gaping. Dorsal margin gently curved, posterior part almost straight, anterior part descending. Posterior angle of dorsal margin obtuse, but well marked. Anteriorly the dorsal margin forms a very indistinct angle, or passes gradually into the anterior margin. Posterior margin descending obliquely, and almost straight or very gently curved, passing into the posterior part of the lower margin in a very sharp curve, which forms the posterior point of the shell. This point is somewhat elevated above the baseline, since the posterior part of the lower margin slopes upward. This part of the lower margin is almost straight. The lowermost point of the lower margin is a little behind the middle, and in front of it the lower margin changes its direction, running upward and forward, so that this lower point forms a blunt projection. The ascending anterior portion of the lower margin is at first almost straight or

very gently curved, and then it curves up into the anterior margin, which is narrowly rounded. The anterior part of the shell does not appear narrower than the posterior. The greatest height of the shell is a little behind the middle, and anteriorly it rather gradually becomes narrower, while posteriorly it tapers very decidedly to the posterior point. Thus there is also no marked obliquity in the shell. (In the young specimen from Santa Rita the posterior taper is not so strong).

Valves moderately convex, diameter 34 to 36 pr. et. of length. Beaks not very prominent above hinge-line, located at 18 to 26 pr. et. of the length. Convexity of the valves greatest over the posterior ridge, least between this ridge and the region of the lower angle of the lower margin. Posterior slope compressed, but hardly any compression at anterior end. A distinct radial rib upon the posterior slope, lying between two radial depressions; sometimes there is a trace of a weak radial rib above it, but generally this is not very distinct. In young specimens the radial rib is indistinct.

Epidermis rather smooth, with irregular concentric lines, which become lamellar upon the posterior slope and towards the ventral margin. No distinct radial sculpture, except some irregular and rather fine scalariform stripes. Color of epidermis normally a very dark green upon the disk, which, however, may turn to brown. The posterior slope may also be dark green, with the shallow grooves brownish, or it may be entirely brown, and in the young specimen it is brown, with the radial rib marked by a rather distinct dark green ray. The disk has no color rays.

Hinge-line practically straight behind the beaks, and in front of them it gently curves down. Ligamental sinus triangular, about as deep as wide, its anterior margin vertical to the hinge-line, or slightly descending backward.

Cavity of shells and beaks moderate. Nacre whitish, more or less iridescent; only in the young specimen with irregular and indistinct radial striae. Prismatic border rather narrow, subconcentric with margin, and nowhere noticeably widened, except very slightly so in the region of the projecting part of the lower margin. Anterior adductor-scar well impressed, subovate, united above with scar of anterior retractor. Anterior protractor-scar united with or separated from that of the adductor. Posterior adductor-scar faint, subovate, the posterior retractor-scar forming a triangular upper projection of it. Pallial line subconcentric to the margin.

According to Wagner, the height would be 57 pr. et. of the length.

*Remarks.*—This species has a quite characteristic shape, which varies only slightly, and the most prominent features are the blunt angle of the lower margin,

the anterior position of the beaks, the sub-pointed posterior end, and the radial rib upon the posterior slope. The dark green color of the disk may also be characteristic, but this is liable to fade; in our specimen from Asunción, a much-worn shell, the remnants of the epidermis are brown.

## MEASUREMENTS.

Localities.	Sex.	Length		Height		Diameter.		Beaks.	
Santa Rita . . . . .	♂	36 mm.	22 mm. = 61 pr. ct. of L.			13 mm. = 36 pr. ct. of L.	at	9.5 mm. = 26 pr. ct. of L.	
Do. . . . .	♀	62 "	37 " = 59 "			22 " = 35 "		11 " = 18 "	
Limay . . . . .	?	68 "	41 " = 60 "			24 " = 35 "		16 " = 24 "	
Asunción. . . . .	?	70 "	42 " = 60 "			24 " = 34 "		16 " = 23 "	
Spix' figure . . . . .		48 "	27 " = 56 "						
D'Orbigny's figure . . . . .			= 54 "			= 34 "			

*Anatomy.*—The soft parts of a young male and a gravid female (collected June 12) are at hand for study.

The typical *Anodontites*-structure is observed. The mantle-connection separating anal and branchial openings is rather long. The branchial opening has extremely fine papillæ. The inner edge of anal and branchial is brown. Palpi of medium size, semicircular, with a short posterior truncation.

In the gravid female the eggs fill the water-tubes of the inner gill, with exception of those near the extreme anterior and posterior ends. The water-tubes are markedly expanded, and the eggs are located in the basal part of the tubes, and only in the inner compartment (ovisac) toward the inner lamina of the gill. No larvæ were seen. The outer gills have the usual structure of alternately thicker and thinner septa, while the septa of the inner gill are more uniform and thicker. The gills of my female are much torn and injured, so that it was not expedient to section them.

## 54. ANODONTITES HYRIOIDES Ortmann, sp. nov.

*Shells:* Plate XLII, figs. 3, 4, 5.

*Type-locality.*—Rio Tapajos, Santarem, Para, Brazil (J. D. Haseman coll., December 6–12, 1909). *Type-act:* Carn. Mus. Cat. No. 61.5829. Six specimens.

*Characters of the Shell.*—Shell moderately thick, angularly subovate, somewhat oblique, pointed behind, lower margin convex, forming a blunt angle. Height 62 to 73 pr. ct. of the length. Valves not gaping. Dorsal margin practically straight, gently descending in front of the beaks. Posterior angle of dorsal margin obtuse, but quite distinct, wing-like. Anteriorly the dorsal margin forms also a more or less distinct angle, which is obtuse or almost a right angle. Posterior margin obliquely descending, straight, or slightly concave in its upper portion,

curving sharply around into the lower margin, thus forming the posterior point of the shell. This point is only a little elevated above the base-line, since the posterior part of the lower margin runs straight forward, being almost parallel to the dorsal margin (there is some variation in this respect; on the average these two margins diverge very slightly towards the front). From a point at, or slightly behind, the middle of the shell the lower margin changes its direction abruptly, running forward and upward, thus forming a lower blunt angle at about the middle of the shell. The ascending anterior part of the lower margin is first almost straight, but then it passes in a curve into the anterior margin, which is narrowly rounded. The shell appears slightly narrower anteriorly, with the greatest height in the posterior part. The taper of the posterior end is stronger than in *A. trigona*, and thus the shell appears somewhat oblique.

Valves more convex than in *A. trigona*, diameter 38 to 46 pr. ct. of the length. The greatest swelling is towards the beaks, but the beaks are not much elevated above the hinge-line, so that they appear rather depressed. Location of beaks at 27 to 31 pr. ct. of the length of the shell. The convexity of the valves is like that of *A. trigona*, compressed upon the posterior slope, and flattened in front of the posterior ridge. Posterior slope with one or two more or less distinct radial ribs, accompanied by shallow depressions.

Epidermis similar in sculpture to that of *A. trigona*, but more frequently with fine scalariform stripes, chiefly upon the anterior part of the shell, producing the appearance of fine radial sculpture. Color of epidermis from dark or light greenish and yellowish to light or dark brown; one specimen inclines more toward olive-green. Most of the specimens are somewhat concentrically banded with lighter and darker color.

Hinge-line straight behind the beaks, inclining downward in front of them, but very little so in the youngest specimens. Ligamental sinus triangular, shaped like that of *A. trigona*.

Cavity of shell moderate, that of beaks somewhat deeper. Naere whitish and iridescent, with indistinct radial striae. Prismatic zone narrow, subconcentric to the margin. Muscle- and mantle-scars as in *A. trigona*.

## MEASUREMENTS.

No.	Length.	Height.	Diameter.	Beaks.	Figured.
1....	32 mm.	22 mm. = 68 pr. ct. of L.	14 mm. = 44 pr. ct. of L.	at 10 mm. = 31 pr. ct. of L.	Pl. XLII, fig. 5.
2....	33 "	24 " = 73 "	14 " = 42 "	9 " = 27 "	
3....	41 "	27 " = 66 "	16 " = 39 "	12 " = 29 "	
4....	42 "	26 " = 62 "	16 " = 38 "	12 " = 29 "	Pl. XLII, fig. 4.
5....	42 "	29 " = 69 "	17 " = 40 "	12 " = 29 "	
6....	52 "	33 " = 64 "	24 " = 46 "	14 " = 27 "	Pl. XLII, fig. 3.

*Remarks.*—This species undoubtedly is closely allied to *A. trigona*, and differs chiefly in the dimensions. It might be a local variety of it, but since all six of my specimens are rather uniform in their characters, I take it for a species.

*A. hyrioides* is an *A. trigona*, which is higher and shorter, more inflated, has the outline more sharply angular, and is more oblique. The obliquity is due to the shortening of the shell and the lower position of the posterior point. The outline of our species recalls the shape of the genus *Hyria*, and hence the name.

#### 55. ANODONTITES MORTONIANA (Lea) (1834).

*Anodonta mortoniana* LEA, Obs. I, 1834, Pl. 13, fig. 37.

*Anodonta weddellii* HUPÉ, 1857, p. 87, Pl. 17, fig. 5.

*Anodonta lingulata* HUPÉ, 1857, p. 89, Pl. 18, fig. 1.

*Anodonta weddellii* and *lingulata* SOWERBY, XVII, 1868, Pl. 20, fig. 80; 1869, Pl. 23, fig. 90.

*Glabaris mortoniana* and *lingulata* VON IHERING, 1893, p. 118, 119.

*Glabaris weddellii*, *lingulatus*, and *mortonianus* SIMPSON, 1900, pp. 928, 929.

*Anodontites weddellii*, *lingulatus*, and *mortonianus* SIMPSON, 1914, pp. 1442-1445.

*Type-locality.*—River Paraná.

*Other Localities.*—Santa Ana de Chiquitos, Bolivia (Hupé, *weddellii*) (situated about on the divide between the drainages of the Paraguay and the Amazon); Corumbá, Matto Grosso, Brazil (Hupé, *lingulata*); Rio Paraguay (Von Ihering); Lower Paraná (Von Ihering).

*New Localities.*—Mountain creek, Sapucay, Paraguay (S. E. of Asunción) (J. D. Haseman coll., April 5, 1909). One male with soft parts. Headwaters of Rio Paraguay, Santa Rita, Matto Grosso, Brazil (J. D. Haseman coll., June 12, 1909). Two specimens, one a male with soft parts.

*Distribution.*—This species apparently belongs to the Paraguay-drainage and the Rio Paraná below its union with the Paraguay. Von Ihering (1893, p. 114) does not mention any of the forms belonging to this species from the upper Paraná.

*Remarks as to Synonymy.*—The three forms, *mortoniana*, *weddellii*, and *lingulata*, are kept as separate species by Simpson, but I do not see any essential differences between them.

Hupé admits that *weddellii* is very close to *mortoniana*, but says that it differs in three respects: more swollen shell; narrower and more rounded anterior end; and deeper and larger muscular impressions. These differences are not substantiated by the figures, in fact, we cannot judge as to the first, since no figure showing the obesity is given. According to the measurements in the text, how-



ever, just the opposite is the case, *mortoniana* being more swollen (40 pr. et.) than *weddelli* (33 pr. et.). The second difference is not at all correct according to the published figures; and the third apparently is founded only upon the slight indication of the muscle-sears in Lea's figure, and is not essential, anyhow. Besides, Hupé says that the specific difference is supported by the different distribution of the two forms. This again is not evident. *A. weddelli* is from the region of the divide between the Amazon and Paraguay-drainages, and it may very well be from the latter. One of our localities is not very far from it. *A. mortoniana* and *weddelli*, indeed, have been united already by Von Ihering (1893, p. 118).

*A. lingulata* differs from the others only in size and the color of the epidermis. The latter, on the plate, is dark green, while the text says that it is blackish brown, and thus we cannot rely on it. The shell of *lingulata* is more regularly elliptical, but this is not astonishing when we consider the greater age of this shell. It is also from the same general region (upper Paraguay) as *mortoniana* and *weddelli*.

Very similar forms are found also in the Amazon-drainage: *castelnaudi* Hupé, *solidula* Hupé, *amazonensis* Lea, and *elongata* Swainson. But these cannot be united with *mortoniana*, since they all are more elongated.

*Characters of the Shell.*—Shell quite thick and solid. Outline subovate or nearly subelliptical, bluntly pointed behind, lower margin gently convex. Height 61 to 63 pr. et. of the length, falling, in old specimens, as low as 53 pr. et. Valves not gaping. Dorsal margin gently convex; the part behind the beaks may be almost straight; in front of the beaks it descends more or less. Posteriorly the dorsal margin forms a blunt angle, or may pass almost insensibly into the posterior margin. There is no distinct angle anteriorly. Posterior margin obliquely descending, more or less convex, curving into the lower margin and forming with it a distinct, but rounded, posterior point of the shell, which is situated at a certain elevation above the base-line, but nearer to the latter than to the line of the upper margin. Lower margin gently and rather regularly curved, ascending somewhat toward the posterior end of the shell, and more strongly so in its anterior part, where it passes in a regular curve into the anterior margin. The anterior part of the shell is only slightly narrower than the posterior, which is widest (highest) a little behind the middle of the shell, and then tapers gently toward the posterior point. The shell is thus transverse, and hardly oblique.

Valves moderately convex, diameter 37 to 41 pr. et. of the length (*weddelli* is more compressed, 33 pr. et.). Beaks moderately convex, not very prominent above hinge-line, at 23 to 25 pr. et. of the length, that is to say, rather anterior. Convexity of valves rather uniform all over the disk, strongest over the posterior ridge, slightly

compressed upon the posterior slope. Posterior slope with one or two blunt radial ribs, which may be more or less distinct, or almost effaced.

Epidermis rather smooth, with irregular concentric lines, which become sublamellar upon the posterior slope and near the lower margin. Traces of radial sculpture are present in the shape of fine scalariform stripes, irregularly disposed upon the shell, and more or less numerous. Color of epidermis brownish or greenish. Upon the disk it may be quite green (dark or light), or it may be darker or lighter brown, with irregular concentric bands of dark green. The posterior slope is (in my specimens) always light brown, with or without greenish tints. No color-rays are seen.

Hinge-line gently curved. In the younger specimens the part behind the beaks is straight; in older ones it is gently curved, and curves down more distinctly under the beaks. Ligamental sinus triangular, about as deep as wide, its anterior margin vertical to the hinge-line.

Cavity of shell and beaks moderate. Nacre whitish, iridescent, only in the youngest specimen with faint traces of radial striae. Prismatic zone very narrow (comparatively widest in the young), subconcentric to the margin. Anterior adductor-scar well impressed, chiefly in the older shells, subovate, united above with the anterior retractor-scar. Anterior protractor-scar united with, or free from, adductor-scar (this may be different in the right and left valves of the same shell). Posterior adductor-scar less impressed, subovate, the posterior retractor-scar forming an upper triangular projection of it. Pallial line subconcentric to lower margin.

## MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
Santa Rita...	52 mm.	33 mm. = 63 pr. et. of L.	20 mm. = 38 pr. et. of L.	at 13 mm. = 25 pr. et. of L.
Sapucay.....	54 "	33 " = 61 "	20 " = 37 "	13 " = 24 "
Santa Rita...	69 "	42 " = 61 "	28.5 " = 41 "	16 " = 23 "

Lea's measurements for *mortoniana* give for the height 53 pr. et. and for the diameter 40 pr. et. of the length. Thus the height is less here, but I think this is due to the greater age of this specimen. My largest specimen has a peculiar shape: the posterior end of the shell is drawn down, so that the lower margin is almost straight. This, however, undoubtedly is an individual character, since the growth-lines indicate that the young shell had the normal shape.

The measurements for Hupé's shells are as follows:

	Length.	Height	Diameters.
<i>Weddelli</i> .....	66 mm.	33 mm. = 53 pr. et. of L.	22 mm. = 33 pr. et. of L.
<i>Lingulata</i> .....	100 "	?	40 " = 40 "

The height of *lingulata* is given as 92 mm., but there surely is a mistake in this statement. According to the figure, it would be 53 pr. et. of the length.

*Remarks.*—The characters of this species are its rather regular, subovate, or subelliptical, outline, with a blunt point behind, somewhat elevated above the base-line. The shell is not very long and of considerable thickness. The peculiar green in the color of the epidermis is remarkable, but is not always present.

*Anatomy.*—The soft parts of two males are at hand for examination.

The structure is typical of the genus. The papillae of the branchial opening are very small. The inner edge of the anal and branchial is brown. The palpi are of medium size, semicircular, with a short posterior truncation, forming the posterior margins, which are not united. The septa of the gills are irregularly stronger and weaker.

56. ANODONTITES HASEMANI Ortmann, sp. nov.

*Shells:* Plate XLII, figs. 6, 7.

*Type-locality.*—Headwaters of the Rio Paraguay, Santa Rita, Matto Grosso, Brazil (J. D. Haseman coll., June 12, 1909). *Type-set:* Carn. Mus. Cat. No. 61.5832. Four specimens, among them two males and a gravid female with soft parts.

*Characters of the Shell.*—Shell moderately thick, outline subovate, narrower in front, broader (higher) behind, not pointed. Height 63 to 67 pr. et. of the length. Valves not gaping. Dorsal margin gently curved, the part behind the beaks almost straight; anteriorly to the beaks it descends distinctly, and passes into the anterior margin in an indistinct, obtuse angle. At the posterior end the upper margin forms a more distinct, obtuse angle. Posterior margin obliquely descending, gently convex, broadly curving around at the posterior end into the lower margin. The latter is gently curved, and runs forward and upward, being almost straight in the anterior part, finally curving up into the anterior margin. Thus the shell is distinctly narrowed anteriorly, the greatest height being located at about the beginning of the posterior third of the shell, and the shell being somewhat oblique.

Valves rather convex, diameter 42 to 47 pr. et. of the length. Beaks rather inflated, but only moderately elevated above the hinge-line, located at 27 to 33 pr. et. of the length. Convexity of valves rather regular, greatest over the posterior ridge, which is indistinct, very slightly compressed upon the posterior slope, without perceptible flattening upon the sides of the disk. Posterior slope with indistinct and faint traces of one or two radial ribs.

Epidermis very slightly shining, with crowded, irregular, fine, subconcentric

lines, becoming lamellar upon the posterior slope and near the lower margin. There are hardly any traces of radial sculpture. Color olive-brown, rather uniform. The smallest specimen has a trace of a dark radial ray upon the posterior slope, otherwise there are no rays, nor indications of growth-rests.

Hinge-line upon the whole gently curved, but the part behind the beaks is practically straight, chiefly in the younger specimens. The part in front is decurved, but in one specimen it distinctly curves up again at the anterior end. Ligamental sinus triangular, hardly as deep as wide, its anterior margin in the largest specimen being vertical, in the others slightly descending backward.

Cavity of shell and beaks rather deep, corresponding to the obesity of the valves. Naere blueish white, with purple and green iridescence, and with very faint radial striae in the younger specimens. Prismatic zone quite narrow, subconcentric with the margin. Anterior adductor-scar not very deeply impressed, subovate, united with the scar of the anterior retractor; scar of anterior protractor separated from it more or less completely. Posterior adductor-scar faint, subovate, with an upper triangular process formed by the posterior retractor. Pallial line subconcentric with the margin.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
1....	♂	45 mm.	30 mm. = 67 pr. et. of L.	19 mm. = 42 pr. et. of L.	at 15 mm. = 33 pr. et. of L.	Pl. XLII, fig. 6.
2....	♂	57 "	36 " = 63 "	24 " = 42 "	17 " = 32 "	
3....	♀	62 "	39 " = 63 "	28 " = 45 "	17 " = 27 "	Pl. XLII, fig. 7.
4....	?	66 "	43 " = 65 "	31 " = 47 "	18 " = 27 "	

*Remarks.*—I cannot find among the described species any one which agrees with the present form. Its chief feature is the broadly rounded posterior end. In this character and in the obliquity it resembles the species of the *patagonica*-group, but it differs from them in the prismatic border, which is narrow. I have placed this species in the *trigona*-group, although it has not the subpointed posterior end, because I could not conveniently place it anywhere else. Of other species, only *A. obtusa* resembles it to a degree, but the latter is somewhat shorter and higher (Height 64 to 69 pr. et. of L.), and not distinctly oblique, with the upper and lower margins more nearly parallel. Besides, *A. obtusa* has a peculiar color-pattern.

*Anatomy.*—Soft parts of two males and one gravid female at hand.

The structure is of the normal *Anodontites*-type. Papillae of the branchial opening very small. Gills with the septa well developed. In the gravid female, the inner gills have the usual marsupial structure, with a swelling at the insertion of the septa on the outer (primary) limb of the gill. The water-tubes contain

eggs in their inner compartments, except at the anterior and posterior ends of the gill; the other compartments forming secondary water-tubes. The septa of the ovisacs are somewhat stretched out, and the gill is slightly distended. I was unable to find fully developed larvæ (lasidia?). All eggs are small, round, globular masses of cells (morula-stage), enclosed in a rather tough membrane. In the males no regular alternation of stronger and thinner septa could be noticed, but all septa are rather uniform. The male character, however, has been positively established by microscopic examination (absence of swellings of the septa).

##### 5. GROUP OF ANODONTITES PATAGONICA.

Simpson, 1914, p. 1403.

Shell strongly oblique, subovate or subrotund, not pointed behind. Epidermis more or less shining, but here and there with wrinkles, or covered all over with concentric striae. Prismatic border rather wide and unequal, being much wider along the anterior lower margin than at the anterior and posterior ends.

The prismatic border forms the most prominent feature of this group. I possess a good number of specimens belonging to the group, and this character is always present, so that we must regard it as of taxonomic value. In addition the shell is here distinctly oblique with a rounded end.

##### KEY TO THE FORMS AT HAND.

- a*<sub>1</sub>. Shell moderately inflated, diameter generally between 40 and 50 pr. et. of the length, rarely less. Outline strongly oblique, moderately elongate, sometimes subrotund, height from about 65 to over 80 pr. et. of length.
  - b*<sub>1</sub>. Shell thick, rather more elongated. Nacre whitish.....*A. patagonica*.
  - b*<sub>2</sub>. Shell thinner, subrotund or elongated. Nacre often red.....*A. patagonica rubicunda*.
- a*<sub>2</sub>. Shell compressed, diameter 36 pr. et. or less. Outline obliquely ovate, rather elongated, height not over 66 pr. et.
  - b*<sub>1</sub>. Prismatic border wide and unequal. Epidermis shining, striae not sublamellar....*A. puechana*.
  - b*<sub>2</sub>. Prismatic border narrower, but unequal. Epidermis not very shining, with the striae often sublamellar.....*A. iheringi*.

##### 57. ANODONTITES PATAGONICA (Lamarck) (1819).

*Anodonta patagonica* LAMARCK, 1819, p. 88; Encyclop. Method., II, 1827, p. 147, Pl. 203, fig. 1.

*Anodontites patagonicus* SIMPSON, 1914, p. 1403.

*Remarks as to Synonymy.*—The synonymy of this species has been given by Simpson, but it needs certain additions and corrections. The following references should be added first of all:

*Anodonta latemarginata* and *uruguayensis* CORSI, 1901, p. 454, 458.

*Anodontites patagonicus* HAAS, 1916, pp. 25, 54.

As we have seen above, *Anodon trapezeum* Spix (1827) should be stricken from the list of synonyms. This is a different species, differing chiefly by the narrow prismatic border. The other references given by Simpson all certainly belong here, and the following names have been used for this species:

*Anodonta latomarginata* LEA (1834).

*Anodonta membranacea* D'ORBIGNY (1843).

*Anodonta solida* KUESTER (1853).

*Anodonta uruguayensis* LEA (1860).

*Anodonta sinuosa* CLESSIN (1873).

*Anodonta serpentina* CLESSIN (1876).

In addition:

*Glabaris bergi* VON IHERING (1893 p. 118), introduced for *sinuosa* Clessin.

But the following forms also belong here as synonyms:

*Anodon crassus* SWAINSON (1823); SIMPSON, 1914, p. 1406. Simpson says: this species is "close to *A. patagonicus*, but I have never seen a specimen of that species quite so elongated or so pentagonal as the figure." The dimensions are: L. 80 mm., H. 52 mm. = 65 pr. et. of length, Diameter 32 mm. = 40 pr. et. of length. These figures agree well with the dimensions of my series of specimens from San Isidro, some of which are even more elongated (height falling as low as 60 pr. et.).

*Anodonta wymani* LEA (1860); SIMPSON, 1914, p. 1407, who says: "More elongated and more richly colored than *A. patagonicus*." The elongation is even greater than in *A. crassus* (Height = 63 pr. et. of length), but it still remains within the limits of variation of my set from San Isidro. Some of the latter undoubtedly are *wymani* in every respect. The color is no reliable character, being very variable in *A. patagonica*.

I am unable to form an opinion as to *A. sirionos* D'Orbigny (1835) (= *ferrarisii* D'Orbigny, 1835). It certainly is nearly related to *A. patagonica*, but, according to the original description, is distinguished by a rough and concentrically and lamellarly striate epidermis. I have no specimens corresponding to this form.

*Type-locality*.—Rio de la Plata and Patagonia.

*Other Localities*.—Rivers of Uruguay between Montevideo and Buenos Aires (D'Orbigny, *membranacea*); Rio Miguelete, Montevideo, Uruguay (Haas); Arroyo S. José, Uruguay (N. W. of Montevideo) (Corsi, *uruguayensis*); Uruguay River (Lea, *uruguayensis*, *wymani*); Rio de la Plata (Haas); Rio de la Plata, Buenos Aires, Argentina (D'Orbigny, *membranacea*); Rio Paraná (Lea, *latomarginata*);

Rio Paraná up to sixty miles above Corrientes, Argentina (D'Orbigny, *membranacea*).

*Localities Represented in the Carnegie Museum.*—Rio Paraná (Hartman collection). One specimen. In pond along banks of Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). One specimen. Arroyo Miguclete, Montevideo, Uruguay (J. D. Haseman coll., February 17, 1909). One specimen. Rio de la Plata, San Isidro, 20 km. N. of Buenos Aires, Argentina (A. Windhausen coll., January, 1917). Twenty specimens with soft parts, males and females.

*Distribution.*—La Plata system, from the mouth near Buenos Aires up the Paraná to the province of Corrientes in Argentina; also in the Rio Uruguay and the Rio Negro, and the tributaries of the La Plata in the Banda Oriental of Uruguay.

*Characters of the Shell.*—Shell rather large (length up to 100 mm. and over), rather thick and solid. Outline very oblique, subovate, longer or shorter, height 60 to 74 pr. et. of the length. Young shells probably higher and more subrotund, according to the growth lines in older shells, but such shells have not been observed (the smallest shell is 75 mm. long). Valves not gaping. Dorsal margin straight or gently curved, generally with a well marked, blunt posterior angle, while the anterior angle is less distinct, often quite rounded. Posterior margin obliquely descending, generally almost straight, rarely gently convex, and very rarely a little concave, curving broadly and regularly into the posterior lower margin, generally forming no angle or posterior point, but sometimes with a trace of it. The anterior part of the ventral margin is strongly ascending and always more or less gently curved, and often almost straight, curving up into the anterior margin, which is narrowly rounded. Thus the anterior end of the shell appears much narrower than the broadly rounded posterior part, rendering the shell decidedly oblique.

Valves moderately swollen, diameter 38 to 44 pr. et. of length, rarely slightly less. Beaks slightly convex, and only little elevated above the hinge-line, located at 28 to 34 pr. et. of the length. Disk moderately convex, more strongly so over the middle part and the posterior ridge; posteriorly compressed. Posterior ridge very indistinct, but often there is a radial rib upon the posterior slope, sometimes accompanied by a furrow. The anterior end of the shell is also slightly compressed.

Epidermis rather smooth, but with fine, irregular, concentric striae, almost effaced in the middle of the disk and toward the beaks, more distinct toward the margins, where they may become sublamellar. Very fine radial, oblique, or reticulated wrinkles may be present between the striae. Scalariform radial stripes are generally absent, but in some specimens slight traces of them are seen. Color of epidermis dark greenish-olive to various shades of brown. Generally there is

more green toward the beaks, more brown toward the margins, but the green may extend over nearly the whole shell, or may be absent. Upon the posterior slope there may be a few indistinct, dark green rays, and the green color near the beaks often has a mottled character, consisting of irregular, darker and lighter concentric bands, and, rarely, of indistinct radial rays or blotches. In some specimens, the anterior and posterior parts of the shell are different in shade, the posterior being darker (more greenish), the two shades being separated rather sharply by a radial line. Growth-rests few, and rarely distinct.

Hinge-line nearly straight, or very gently curved behind the beaks. In front of them it descends more or less distinctly, and may ascend again at the anterior extremity, thus becoming slightly sinuate. Ligamental sinus triangular, somewhat variable, but generally deeper than wide, chiefly in older shells, its anterior margin mostly vertical to the hinge-line, and its lower point curved more or less forward. Often the anterior margin has an S-shaped curve.

Cavity of shell and beaks moderate. Naere whitish, iridescent, but none of my specimens has red tints. Radial striations are present, but indistinct in older shells. Prismatic border broad, unequal in width, broadest along the ascending anterior lower margin, narrower in front, and narrowing rather suddenly at the beginning of the posterior part of the lower margin. Its color is grayish or yellowish green, or grayish or yellowish white. Anterior adductor-scar well impressed, subelliptical, united above with that of the retractor, or sometimes incompletely separated. Anterior protractor-scar generally well separated from the adductor-scar. Posterior adductor-scar less impressed, subovate, with an upper triangular projection formed by the posterior retractor-scar. Pallial line distinct, subconcentric with the shell-margin, and thus more closely approaching the prismatic border in the anterior part of the lower margin than before and behind it. No dorsal scars.

## MEASUREMENTS.

Locality.	No.	Sex.	Length.	Height.	Diameter.	Beaks.
San Isidro.....	19	♂	75 mm. 53	mm. = 71 pr. et. of L.	30 mm. = 40 pr. et. of L.	at 25 mm. = 33 pr. et. of L.
Do. ....	14	♂	87 " 56	" = 64 "	38 " = 44 "	29 " = 33 "
Do. ....	10	♀	89 " 62.5	" = 70 "	39 " = 44 "	25 " = 28 "
Do. ....	2	♀	91 " 67	" = 74 "	36.5 " = 40 "	27 " = 30 "
Do. ....	20	♀	93.5 " 56	" = 60 "	39 " = 42 "	26 " = 28 "
Do. ....	8	♂	103 " 66.5	" = 65 "	37 " = 36 "	31 " = 30 "
Montevideo.....	?	?	77 " 51	" = 66 "	30 " = 39 "	26 " = 34 "
Santa Isabel.....	?	?	98 " 67	" = 68 "	42 " = 43 "	33 " = 34 "

## PREVIOUS MEASUREMENTS.

D'Orbigny ( <i>membranacea</i> )	90	"	"	" =73	"	"	" =33	"
Simpson ( <i>patagonica</i> )	81	"	59	" =73	"	32	" =40	"
Do.	87	"	57	" =66	"	37	" =43	"
Simpson ( <i>crassa</i> )	80	"	52	" =65	"	32	" =40	"
Simpson ( <i>wymani</i> )	80	"	50	" =63	"	30	" =38	"
Lea (figure of <i>wymani</i> )	87	"	55	" =63	"	33	" =38	"



All of these previous measurements fall within the range of variation of my series, with the exception of the diameter given by D'Orbigny, which is somewhat lower (33 pr. et.) than any of my figures (lowest 36 pr. et.).

*Remarks.*—This species is very variable in shape, being sometimes higher, sometimes more elongated. There is no indication that the shape is connected with sex. Since no very young specimens are at hand, and never have been observed, we do not positively know anything about their shape, but from the growth-lines of the old specimens it is seen that the young shell generally must have been comparatively higher: the shell grows, with advancing age, more in the direction of the posterior end, so that the longitudinal diameter increases more than the vertical.

There is no doubt in my mind that *A. crassa* and *wymani* belong here, and that they represent specimens which are a little more elongated than the average; but among the set from San Isidro, I have specimens which represent even greater extremes than these.

*A. patagonica* is rather thick and solid, but varies also in this respect. The specimen from Montevideo at hand is not quite as thick as the others, but agrees with them in other respects, being also rather elongated. Just such specimens induce me to regard the next form (*rubicunda*) as a variety of *patagonica*.

*Anatomy.*—Soft parts of eight males, one barren, and eleven gravid females have been investigated. The breeding season is January.

The anatomy of *latomarginata* and *wymani* has been previously described by Lea (Obs. X, 1863, pp. 391, 394) as far as the superficial characters of the gills, the palpi, and the branchial and anal openings are concerned.

Von Ihering (1891, p. 480) describes the eggs and lasidia of *Glabaris wymani*, the former being 0.09 mm. in diameter, the latter 0.086 mm. long. However, since he says that his specimens are from Rio Camaquã, I am not sure that they have been properly identified. They might belong to *A. iheringi* (Clessin).

Anal opening entirely open, separated from the branchial by a connection of the mantle-margins. Inner edge of anal smooth above, very finely crenulated near the lower end. Branchial opening with small papillæ. Palpi nearly semi-circular, longer than high, behind abruptly truncated, the posterior margins connected at base.

Gills rather wide, the inner much wider than the outer in front, its anterior end immediately behind the palpi, and attached along the whole space between the palpi and the anterior end of the outer gill. Inner lamina of inner gill entirely connected with abdominal sac. Septa of the gills well developed. In the non-

marsupial gills they are irregularly alternating. In the female, the *inner* gill is *marsupial* nearly throughout its whole length. The septa are stronger and equal, having near the outer lamina a swelling indicating ridges projecting into the lumen of the water-tubes. When charged the egg-masses occupy only the inner compartments, forming ovisacs, which are somewhat distended, while the outer compartments do not change, and apparently serve as (secondary) water-tubes. Eggs very small. I did not see any larvæ. Even in a specimen which had the gills only partially charged (anteriorly), and which might have been discharging, the eggs consisted only of a globular mass of cells enclosed in a membrane.

57a. *ANODONTITES PATAGONICA RUBICUNDA* (Lea) (1860).

*Diagram of soft parts:* Text-fig. 3, p. 458.

*Section of gills:* Plate XLVIII, fig. 8.

*Anodonta rubicunda* LEA, Obs. X, 1863, Pl. 46, fig. 299; CORSI, 1901, p. 455.

*Anodonta pazii* LEA (1866) Obs. XII, 1869, Pl. 36, fig. 87.

*Anodon rubicundus* SOWERBY, XVII, 1870, Pl. 30, fig. 118.

*Glabaris rubicunda* PILSBRY & RUSH, 1896, p. 81; SIMPSON, 1900, p. 913.

*Glabaris latomarginatus felix* PILSBRY, 1896, p. 563, Pl. 26, fig. 8.

*Glabaris pazii* SIMPSON, 1900, p. 918.

*Anodontites latomarginata felix* SIMPSON, 1914, p. 1405.

*Anodontites pazi* SIMPSON, 1914, p. 1408; Haas, 1916, pp. 30, 55.

*Anodontites rubicundus* SIMPSON, 1914, p. 1409.

*Type-locality.*—Uruguay River.

*Other Localities.*—Rio de la Plata, Colonia, Uruguay (Pilsbry & Rush, *rubicunda*) (Pilsbry, *felix*); Uruguay River, Paysandu, Uruguay (Pilsbry & Rush); Uruguay River, Salto Oriental, Uruguay (Haas).

*New Localities.*—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman, February 5, 1909). Twelve specimens, eleven of them with soft parts, males and females. In pond along banks of Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). Three specimens. Rio Ibicuihy, Cacequy, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 1, 1909). One male with soft parts. Rio Cacequy (in sand), Cacequy, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 2, 1909). One female with soft parts.

*Distribution.*—Known only from the Uruguay and the Rio de la Plata below the mouth of the Uruguay, and from the Rio Negro in Uruguay and Rios Ibicuihy and Cacequy in Rio Grande do Sul, these being tributaries of the Uruguay.

Closely allied to *A. patagonica*, but differing in being somewhat smaller (maximum length 84 mm.), with a thinner shell. The outline of the shell is more nearly and more frequently subrotund, and the diameter ranges higher (up to 50 pr. ct.). The nacre very often, but not always, has reddish or purple tints.

## MEASUREMENTS (SPECIMENS FROM URUGUAYANA).

No.	Sex.	Length.	Height.	Diameter.	Beaks.
1.....	♂	47.5 mm.	36.5 mm. = 77 pr. ct. of L.	19.5 mm. = 41 pr. ct. of L.	at 17 mm. = 36 pr. ct. of L.
b.....	♀	53 "	44.5 " = 84 "	24.5 " = 46 "	19 " = 36 "
r2.....	♀	59 "	42 " = 71 "	22 " = 37 "	20 " = 34 "
d.....	♀	62 "	50 " = 81 "	31 " = 50 "	24 " = 39 "
3.....	♂	66 "	49 " = 74 "	27 " = 41 "	22 " = 33 "
e.....	♀	75 "	58 " = 77 "	33 " = 44 "	22.5 " = 30 "
4.....	♀	84 "	59 " = 70 "	35 " = 42 "	29 " = 35 "

## OLDER MEASUREMENTS.

Simpson, <i>rubicunda</i> .	59 "	51 "	= 86 "	30 "	= 51 "	(Type)
Do.	77 "	61 "	= 79 "	36 "	= 48 "	
Simpson, <i>pazi</i> .....	60 "	43 "	= 72 "	26 "	= 43 "	(Type)
Do.	53 "	38 "	= 72 "	26 "	= 49 "	
Pilsbry, <i>felix</i> .....	49 "	35 "	= 71 "	18 "	= 37 "	
Do.	53 "	38 "	= 72 "	20.5 "	= 39 "	

*Remarks.*—All the previous measurements fall within the range of variation of my specimens, only the type of Lea's *rubicunda* is higher, shorter, and more swollen than any of my specimens. Thus we are to regard the type of *rubicunda* as an exceptional specimen, which is also peculiar in the fact that the posterior margin forms nearly a right angle with the upper margin. All these peculiar features are correlated, however. The *normal* type of this form is better represented by Lea's *pazi*; yet there are specimen in my material which distinctly approach the *rubicunda*-type.

It is unknown whether this form ever reaches the size of *A. patagonica*, and in the absence of young specimens of the latter it is impossible to compare them directly. But it seems that the more nearly rotund shape is rather a juvenile character, although there are young specimens in my material which are more elongated. From the measurements given it is seen that the height ranges from 70 to 84 pr. ct. in my material, reaching 86 pr. ct. in Lea's type of *rubicunda*, while it ranges from 60 to 74 pr. ct. in *patagonica*. The diameter in *rubicunda* is from 37 to 50 pr. ct. (51 pr. ct. in the type), while in *patagonica* it is from 36 to 44 pr. ct.

Clearly height and diameter are correlated, a shorter and higher shell being also more swollen than a more elongate one. The slight difference in the location of the beaks (30 to 39 pr. ct. in *rubicunda*, 28 to 34 pr. ct. in *patagonica*) is also connected with this. Finally it may be that all these differences in the shape are connected with age, and this may be true also of the thickness of the shell. How-

ever, my largest specimens of *rubicunda* differ in this from the smallest specimens of *patagonica* (of about the same size), but not very strikingly.

Much stress has been laid in the original descriptions of *A. rubicunda* and *pazi* upon the red color of the naere. According to my material this is extremely variable. In some specimens the color does not differ from that of *A. patagonica*, being whitish. In others it is more or less tinted with red or purple, and then also, generally, the prismatic border is dull purplish gray. But this also is not a constant character.

Pilsbry's *felix* is said to be characterized by its light, yellow-green epidermis, which has radiating or irregularly zig-zag lines of green. I see traces of this in some of my specimens from Uruguayana and Santa Isabel, and there are also here and there black markings on the inside along the pallial line and near the muscle-scars (and elsewhere), mentioned by Pilsbry as occurring in *felix*. These are individual characters.

The epidermis of *rubicunda* is much as in *patagonica*, i.e., somewhat lamellar near the margins, smoother in the middle. Scalariform stripes are sometimes indicated, but are mostly absent. The color in younger specimens is generally dark green all over the shell, but a few are brownish. Those with intense red tints on the inside are sometimes a little reddish brown on the outside. The largest specimen in the color of the epidermis is much like *patagonica*, brownish, inclining to olive toward the beaks.

D'Orbigny says of *patagonica* (*membranacca*) that it is very variable; that it is larger and thicker in the larger rivers; more elongated in lakes; and that it becomes reddish on the inside in small rivers. My specimens support the latter observation, for they all are, so far as they may be called *rubicunda* and have red naere, from comparatively small rivers (Rio Negro, upper Uruguay, Ibicuh, and Cacequy). But, of course, this requires further study and more material.

*Anatomy:* The soft parts of six males and seven females are at hand, one of the latter gravid (February 5).

The anatomy of two males of *pazi* has been described by Lea, but only the major features have been mentioned. According to my material the soft parts agree entirely with those of the typical *patagonica*. In the gravid female the swelling of the charged *marsupium* is not considerable. The small eggs hang loosely together, and easily fall apart. No fully developed larvæ could be found. A diagrammatic figure of the soft parts is given in text-figure 3 (p. 458), and the structure of the gills of a barren female in cross-section is shown on Pl. XLVIII, fig. 8.

## 58. ANODONTITES PUELCHANA (D'Orbigny) (1835).

*Anodonta puelchana* D'ORBIGNY, 1843, p. 620, Pl. 79, figs. 7-9.

*Glabaris puelchanus* SIMPSON, 1900, p. 921.

*Anodontites puelchanus* PILSBRY, 1911, p. 609.

Simpson (1914, p. 1420) unites this with *A. limnoica* D'Orbigny, but the latter has a very narrow prismatic border. According to my observations, the width of this border is a very constant and important character. Simpson places this species in the group of *crispata*; but there is not the slightest trace of the characteristic sculpture of the epidermis of this group. That Simpson has entirely misunderstood this species is shown by the fact that he unites *A. obtusula* Hupé with it. The latter is a species which is not at all oblique.

*Type-locality*.—Marsh of San Xavier on Rio Negro, above Carmen de Patagones, Argentina.

*Additional Locality*.—Twelve leagues from Chichinal, Patagonia (on Rio Negro) (Pilsbry).

*New Locality*.—Rio Limay, Patagonia (drainage of Rio Negro) (W. Israël donor). Two specimens with soft parts, male and female.

*Distribution*.—Known only from the Rio Negro-drainage in Patagonia. Von Ihering (1893, p. 118) lists it as from the lower Paraná, but without substantiating this record.

According to D'Orbigny's description and figure, this species is an obliquely-ovate, much compressed, thin shell, with shining epidermis, and wide prismatic border. It is surely related to *patagonica*, being, however, not so high and more elongated (height 57 to 65 pr. et. of length, while *patagonica* has the height 60 to 84 pr. et. The diameter is about 31 pr. et. while in *patagonica* it never falls below 33 pr. et. and only rarely below 40 pr. et.

The two specimens before me have the wide prismatic border, somewhat unequal in width; the nacre is whitish with pinkish shades (D'Orbigny says "blanc-rose"). The epidermis is highly polished and shining; there are some concentric grooves, but the fine concentric striae are missing upon the greater part of the disk, and are only slightly developed near the margins. There are, chiefly in my larger specimen, a few scalariform stripes upon the anterior part of the shell, consisting of radial bands of short, concentric wrinkles. Upon the posterior slope there is an indication of a radial rib. Color of epidermis greenish brown, more greenish toward the beaks, more brownish toward the margins, with very indistinct traces of green rays upon the posterior slope.

## MEASUREMENTS.

No.	Sex.	Length.	Height.	Diameter.	Beaks.
1....	♂	40 mm.	26 mm. = 65 pr. ct. of L.	12.5 mm. = 31 pr. ct. of L.	at 13.5 mm. = 34 pr. ct. of L.
2....	♂	65 "	40 " = 62 "	20 " = 31 "	21 " = 32 "
D'Orbigny.		60 "	= 57 "	= 31 "	

*Anatomy*.—The soft parts of the male and female at hand are not in good condition, the female being the better of the two. The usual structure of the genus, however, could be made out, and no special features require mention.

## 59. ANODONTITES IHERINGI (Clessin) (1882).

*Shells*: Plate XLII, fig. 8; Plate XLIII, fig. 1; Plate XLIV, fig. 1.

*Anodonta iheringi* CLESSIN, Malakozoöl. Blätt., V, 1882, p. 191, Pl. 4, fig. 5.

*Glabaris iheringi* SIMPSON, 1900, p. 919.

*Anodontites sirionos iheringi* SIMPSON, 1914, p. 1408.

*Type-locality*.—Taguara del Mundo Novo, Rio Grande do Sul, Brazil (system of Rio Guahyba, N. E. of Porto Alegre).

*New Localities*.—Rio Jacuhy, Cachocira, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 26, 1909). One young specimen, with soft parts, sex not determined. Rio Vaccahy-Mirim, Santa Maria, Rio Grande do Sul, Brazil (J. D. Haseman coll., January 29, 1909). Three specimens, with soft parts, two males and a female.

*Distribution*.—Guahyba-drainage in Rio Grande do Sul.

This species very closely resembles *A. patagonica*, but is more elongated and oblique, so that in outline it is still more like *A. puelchana*. To the latter species it is related also in the more compressed shell.

The shell is rather thin, of medium size. The outline is obliquely ovate, narrower anteriorly, broader (higher) posteriorly. The lower margin ascends in its anterior portion, and may be gently curved or nearly straight. Valves gently convex, rather compressed. The prismatic border is not so wide as in *patagonica* and *puelchana*, but it is of the same general character, being wider along the anterior lower margin. It is of a grayish green color. The nacre is silvery white, highly iridescent, often greenish or grayish discolored. Ligamental sinus about as deep as wide, its anterior margin vertical, with the point bending forward.

The chief difference from *patagonica*, and especially from *puelchana*, is in the texture and color of the epidermis. The latter is brownish or brownish olive, not very shining, covered with close, subconcentric striæ, sublamellar near the margins. Scalariform stripes are distinct upon the anterior half of the shell,

consisting of radial bands of short, subconcentric wrinkles. These stripes may also be seen upon the posterior section of the shell, but less frequently and less distinctly.

## MEASUREMENTS.

Location.	No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
Cachoeira . . .	?		22.5 mm.	14.5 mm. = 64 pr. ct. of L.	8 mm. = 35 pr. ct. of L. at	6.5 mm. = 29 pr. ct. of L.	
Santa Maria . .	1	♂	53	" 35 " = 66 "	18 " = 34 "	17 " = 32 "	Pl. XLII, fig. 8.
Do.	2	♂	56	" 36.5 " = 65 "	20 " = 36 "	18 " = 32 "	Pl. XLIII, fig. 1.
Do.	3	♀	69	" 43 " = 62 "	25 " = 36 "	21.5 " = 31 "	Pl. XLIV, fig. 1.

Simpson's measurements are: Length 61 mm.; Height 39 mm. = 64 pr. ct. of L.; Diameter 22 mm. = 36 pr. ct. of Length.

*Remarks.*—The original description and that given by Simpson are scarcely sufficient to enable the species to be recognized, but none of the characters given conflict with those exhibited by my specimens, and the measurements apply very well. Since the original *A. iheringi* comes also from the same river-system (Guaíba) as my specimens, I have no doubt that we are dealing with this species.

*Anatomy.*—Two males, and one female are at hand for study.

The soft parts are absolutely identical with those of *A. patagonica*.

6. GROUP OF *Anodonta trapesialis*.

Shell strongly oblique, subovate to subtrapezoidal, narrowly rounded, or bluntly pointed behind. Epidermis shining, only here and there, and not always, with scalariform radial bands of wrinkles. Prismatic border narrow and of equal width.

A rather well defined group, distinguished also by the large and comparatively thin shell: the largest species of the genus belong here. Usually we discover that the valves are gaping anteriorly, and sometimes also posteriorly. Whether this is connected with the anatomical structure, or with habits, is not known. There is hardly a question that the genus *Leila* is descended from forms belonging to this group.

Von Ihering has given a partial key to the species (1890, p. 157), which I have used to great advantage. But great difficulties arise in distinguishing the species, and young individuals are often very hard to correlate with older ones. Although I possess good material representing this group, it includes only comparatively few forms, so that I am unable to form a definite opinion as to those which are not represented. I treat my specimens here under the names to which they seem to belong, without going into detail as to their affinities and relationships.

## 60a. ANODONTITES TRAPESIALIS ANSERINA (Spix) (1827).

Simpson, 1914, p. 1430.

*New Locality*.—Rio Paraguay, Corumbá, Matto Grosso, Brazil (H. H. Smith coll.). Three right valves.

I do not propose to go into a lengthy discussion of this form. I merely desire to say that two of my specimens agree very well in shape and size, with the figures given by Spix, while the third more resembles Sowerby's figure (Pl. 31, fig. 125). They vary slightly among themselves in the degree of the taper of the anterior end. In all of them the hinge-line is very gently curved, but not sinuous (as in *A. exotica*).

The original *A. anserina* is from the Rio Solimoes, in the province of Amazonas.

## 60b. ANODONTITES TRAPESIALIS SCRIPTA (Sowerby) (1867).

Simpson, 1914, p. 1430.

Simpson unites with this *A. bahiensis* Kuester (Von Ihering, 1890, pp. 153, 157; 1893, p. 115; 1910, p. 138).

No exact localities are known. *A. bahiensis*, which is given from Bahia, is not from that region, but, according to Von Ihering (1910) from the upper Amazon and Ecuador. Von Ihering (1890, p. 152) thinks, on the other hand, that *scripta* is identical with *exotica*.

*New Locality*.—Rio Ribeira, Iguapé, São Paulo, Brazil (Hasegan collection, collected by Richardo Krone). Two odd valves, right and left.

My specimens agree well with Sowerby's (Pl. 4, fig. 9) in shape and size. One of them has the characteristic zig-zag black markings on the inside, while in the other one these are found only near the posterior adductor-scar. However, the color of the epidermis in both is not brownish, but green, darker upon the posterior slope. Very obscure green rays are seen on some parts of the disk. Since Simpson says that the color of the epidermis varies to the "ordinary" (green) color, I do not think that this prevents the union of our specimens with *scripta*. My left valve has anteriorly two short scalariform stripes, barely visible; in the right valve such are entirely absent.

## MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
Left. ....	154 mm.	93 mm. = 60 pr. et. of L.	50 mm. = 32 pr. et. of L.	at 61 mm. = 40 pr. et. of L.
Right. ....	160 "	96 " = 60 " "	48 " = 30 " "	60 " = 38 " "



## 61. ANODONTITES MORICANDI (Lea) (1860).

Simpson, 1914, p. 1439.

Synonym:

*Anodonta hertwigi* VON IHERING, 1890, p. 150, Pl. 9, fig. 7; 1910, p. 138.

Von Ihering (1910, p. 138) regards *Anodon radiatus* Spix (1827) as the young of this species, and in that case, of course, the specific name *radiata* should supersede that of *moriciandi*. However, I am not convinced that this is right, for those of our specimens which are nearly of the size of Spix' original, do not agree with it in shape. They do not have the strongly convex lower margin, and the relative dimensions, chiefly the height, also do not fit. According to Von Ihering, the measurements of *radiata* are: Length 70 mm.; Height 36 mm. = 51 pr. ct. of L.; Diameter 20 mm. = 29 pr. ct. L.

*Type-locality*.—Bahia, Brazil.

*Other Localities*.—Rio São Francisco, Villa Nova, Sergipe, Brazil (Von Ihering); Rio Paraguassú, Bahia, Brazil (Von Ihering); Rio Pardo, Bahia, Brazil (Von Ihering).

*New Locality*.—In a lagoon of Rio Parahyba, Campos, Rio de Janeiro, Brazil (J. D. Haseman coll., June 14, 1908). Six specimens.

*Distribution*.—Streams of eastern Brazil, from mouth of Rio São Francisco in Sergipe southward to Rio Parahyba in Rio de Janeiro. Known from the rivers São Francisco, Paraguassú, Pardo, and Parahyba.

My specimens agree well with this species. What is regarded as one of its essential characters, the flattening of the disk on the sides, is developed only in larger specimens. My largest specimen shows it distinctly, although not as strikingly as Lea's figure. In the smaller ones this is less evident, but even in these the greatest diameter of the shell is in about the middle of the length, not much behind the beaks.

## MEASUREMENTS.

Length.	Height.	Diameter.	Beaks.	
30.5 mm.	17 mm. = 56 pr. ct. of L.	10 mm. = 32 pr. ct. of L.	at 11 mm. = 36 pr. ct. of L.	
49 "	28 " = 57 "	17.5 " = 36 "	18 " = 37 "	
75 "	45 " = 60 "	25 " = 33 "	24 " = 32 "	
78 "	44.5 " = 57 "	23.5 " = 30 "	25.5 " = 33 "	
89 "	50.5 " = 57 "	25.5 " = 29 "	29 " = 33 "	
98 "	57 " = 58 "	30 " = 31 "	34 " = 35 "	
104 "	61 " = 59 "	32 " = 31 "	30 " = 29 "	(Lea's fig.)
117 "	70 " = 60 "	35 " = 30 "		(Simpson)
110 "	62 " = 56 "	less than 34 "		(hertwigi)

## 62. ANODONTITES RIOGRANDENSIS (Von Ihering) (1890).

*Shells*: Plate XLIII, figs. 2, 3; Plate XLIV, fig. 2.

*Anodonta riograndensis* VON IHERING, 1890, pp. 154, 158.

*Glabaris riograndensis* VON IHERING, 1893, pp. 118, 119.

*Anodonta exotica* CORSI (*non* LAMARCK), 1901, p. 456, fig. 37.

It is quite possible that *A. exotica* of D'Orbigny (*non* Lamarek) represents chiefly this species. However, on account of the great diameter (44 pr. et. of length) of the specimen measured, this appears to be rather *A. forbesiana*. Since there is no figure given, D'Orbigny's species remains doubtful. The figure of *A. exotica* given by Corsi certainly in this species.

*Type-locality*.—Rio Grande do Sul, Brazil.

*Other Localities*.—Rio Paraguay (Von Ihering); Lower Paraná and La Plata Rivers (Von Ihering); Rio Uruguay (Von Ihering); Department of Colonia, Uruguay (Corsi); Arroyo Mendoza, Department Florida, Uruguay (Corsi); Montevideo, Uruguay (Von Ihering).

*New Localities*.—In a pond along banks of the Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). Two males with soft parts, four odd right vales. Headwaters of Rio Paraguay, Santa Rita, Matto Grosso, Brazil (J. D. Haseman coll., June 12, 1909). One specimen. Rio de la Plata, San Isidro, 20 km. N. of Buenos Aires, Argentina (A. Windhausen coll., January 1917). Three specimens, male, and gravid females, with soft parts.

*Distribution*.—La Plata-drainage from Buenos Aires up to the headwaters of the Paraguay in Matto Grosso; in the Uruguay and its tributaries; and also in streams of the Banda Oriental to Florida and Montevideo. According to Von Ihering occurring also in the Rio Grande do Sul, but exact localities not known.

*Characters of Shell*.—Shell large (length up to 130 mm. and over), moderately and variably solid, but never thin. Valves distinctly gaping anteriorly, slightly so posteriorly. Outline subtrapezoidal, rather elongated, height 54 to 63 pr. et. of the length, distinctly oblique. Upper margin gently curved or nearly straight, forming a more or less distinct, obtuse angle with the posterior margin, and also with the anterior margin. Sometimes in old specimens these angles are obliterated. Posterior margin obliquely descending, not very steep, straight, or gently convex, curving around into the posterior lower margin, forming a blunt posterior point of the shell, situated a little above the base-line. Lower margin convex, but ascending in its anterior part, and becoming here nearly straight for a distance just in front of the middle; then curving up into the anterior margin. Thus the shell is distinctly narrower anteriorly, and this produces the oblique shape. Often

this shape is obscured on an external view on account of the elevation of the beaks, but it is best seen from the inside, when the ligament behind the beaks is placed horizontally.

Valves moderately convex, somewhat flattened upon the sides, greatest diameter 34 to 40 pr. et. of the length, located upon the posterior ridge, some distance behind the beaks. Posterior ridge indistinct. Posterior slope compressed, sometimes with traces of a radial ridge and furrow. Beaks a little inflated and a little elevated above the hinge-line, their tips located at 29 to 33 pr. et. of the length.

Epidermis rather smooth and shining. Irregular subconcentric ridges are present, but no lamelliform striæ, except on the posterior slope, where they may be more or less distinct, and rather crowded. Upon the smooth part of the disk there are often a few radial scalariform stripes, consisting of short subconcentric wrinkles. But these may be entirely missing. Color of epidermis prevailing green, but shading into brown, often with concentric bands of darker or lighter green and brown. Green rays may be present or absent; when present, they are best developed on and just in front of the posterior ridge. Posterior slope generally dark green to blackish, often with a few black rays.

Hinge-line nearly straight behind the beaks, but gently and distinctly curving down anteriorly, so that the whole hinge-line appears as gently curved. A trace of a slight sinuation may be observed in a very obscure elevation of the hinge-line at its anterior end, but generally this is not the case. Ligamental sinus broad and deep, in older specimens deeper than in younger ones, its anterior margin running obliquely backward in young individuals, but being vertical in old ones. Sometimes the anterior margin is curved, the lower point turning forwards.

Cavity of shell and beaks moderate, corresponding to the obesity of the shell. Nacre whitish and iridescent, often much discolored, and quite frequently there are fine, irregular, subconcentric, waved, or zig-zag, black lines inside of the shell, chiefly near the pallial line. Faint radial striations may be present in young specimens. Prismatic border narrow or very narrow, subequal in width, grayish green or brownish green.

Anterior adductor-scar slightly impressed, irregular in outline, with an upper process representing the anterior retractor-scar. Anterior protractor-scar separated from adductor-scar. Posterior adductor-scar faint and often indistinct, the posterior retractor forming an upper triangular process thereof. No dorsal scars. Pallial line subconcentric to the margin.

*Remarks.*—The height is given by Von Ihering as from 49 to 57 pr. et. of length, thus being less on the average than in my specimens; but I think this is due to the

fact that Von Ihering did not measure in the way I did (See p. 526). If I measure the length of my specimens along the longest axis (diagonally), and the height vertically to it, I obtain for the above specimens figures more nearly agreeing with those of Von Ihering from 51 to 59 pr. et. of length.

## MEASUREMENTS.

Localities.	No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
Santa Isabel.	3	?	95 mm.	59.5mm. = 63 pr.et. of L.	32 mm. = 34 pr. et. of L. at 28 mm.	= 29 pr. et. of L.	
Do.	4	?	102 "	55 " = 54 "	38 " = 37 "	29.5 " = 29 "	
Do.	a	♂	107 "	63 " = 59 "	43 " = 40 "	36 " = 30 "	
San Isidro...	y	♀	123 "	74 " = 60 "	48 " = 39 "	36 " = 29 "	Pl. XLIII, f. 2.
Do.	x	♂	123.5 "	76.5 " = 61 "	49 " = 40 "	36 " = 29 "	Pl. XLIII, f. 3.
Do.	z	♀	136 "	86 " = 63 "	54 " = 40 "	45 " = 33 "	Pl. XLIV, f. 2.

In other respects, the characters given by Von Ihering for *riograndensis* agree with my specimens. This is especially true of the diameter, which, according to Von Ihering ranges from 30 to 39 pr. et., and in my specimens from 34 to 40 pr. et. Von Ihering believes that the diameter as well as the height differ according to sex. According to my material there surely is no such differentiation. It is impossible to directly compare my measurements for the location of the beaks (29 to 33 pr. et.) with those given by Von Ihering, because he measured the distance from the anterior end of the hinge-line (34 to 43 pr. et.); but I should say that measurements of my specimens taken in the same way give, for the above specimens, the values: 36, 35, 37, 43, 40, 44 pr. et. of length, agreeing fully with Von Ihering's.

The point of the beaks is inclined forwards, as Von Ihering mentions, but not too much stress should be laid upon this character. An important feature, however, is the curved hinge-line.

*Glabaris trapesialis cygneiformis* Pilsbry (1896, p. 563, Pl. 26, figs. 4, 5) from Maldonado, Uruguay, surely is closely allied. But, as Pilsbry points out, it is more compressed than *riograndensis* (Diam. only 26 pr. et.), and its posterior end is more elevated above the base-line; it is thus less oblique. For this reason I cannot unite it with the present species, although it may fall under it.

*Glabaris simpsonianus* Pilsbry (ibid., p. 564, Pl. 27, fig. 13) from Rio de la Plata, is also very much like *riograndensis*. The height of 56 pr. et. and the diameter of 38 pr. et. fall within the range of variation of *riograndensis*. But it is said to be a very solid shell, of a rather regular, oblong-oval shape, with a large, elongated anterior protractor scar. Having no specimens corresponding to it, I cannot express an opinion.

*Anatomy.*—The soft parts of three males and two gravid females are at hand,

the latter collected in January. Von Ihering found gravid females with lasidia on May 28.

Anal opening entirely open, its inner edge smooth, separated from the branchial opening by a mantle-connection. Branchial opening with fine papillæ on inner edge. Palpi very large, nearly semicircular, lower margins rounded, posteriorly truncated, without a posterior point. Posterior margins widely separated at base (this is a peculiar feature, not observed in any of the foregoing species).

Gills long and wide, the inner the wider anteriorly, its\* anterior end inserted between the posterior ends of the palpi (this is also a peculiar feature). Outer gill with the anterior end at the highest point of the mantle-attachment-line. Inner lamina of inner gill entirely connected with abdominal sac. Gills with well developed septa running in the direction of the gill-filaments, alternately (but irregularly so) stronger and weaker in the non-marsupial gills. The inner gill of the female is *marsupial*, with stronger, more uniform septa, which, however, are not more closely set, and have the usual vertical ridges near the outer lamina, projecting into the lumen of the water-tubes. When charged, only the inner compartment is filled with ova, thus becoming an ovisac, while the outer compartment remains a (secondary) water-tube. Egg-masses only loosely hanging together. Eggs very small, according to Von Ihering 0.071 to 0.090 mm. in diameter, while I have found them to be about 0.08 mm. In this species also I have not been able to find mature larvæ, but this is one of the species, in which Von Ihering has observed the *lasidium*, which he describes as being 0.1 mm. long.

63. ANODONTITES FORBESIANA (LEA) (1860).

*Shells*: Plate XLIII, fig. 4; Plate XLIV, fig. 3.

Simpson, 1914, p. 1438.

*Additional References*.—*Anodonta forbesiana* VON IHERING, 1890, p. 158. CORSI, 1901, p. 457.

*Glabaris forbesianus* PILSBRY & RUSH, 1896, p. 81.

*Type-locality*.—Uruguay River.

*Other Localities*.—Rio de la Plata, Colonia, Uruguay (Pilsbry & Rush).

*New Localities*.—Rio Uruguay (in mud), Uruguayana, Rio Grande do Sul, Brazil (J. D. Haseman coll., February 5, 1909). Fourteen specimens, males and females, all with soft parts. In pond along banks of Rio Negro, Santa Isabel, Uruguay (J. D. Haseman coll., February 11, 1909). Two odd right valves.

*Distribution*.—Known only from the Rio de la Plata below the mouth of the Uruguay, Rio Uruguay up to Rio Grande do Sul, and its tributary the Rio Negro.

Simpson also gives Peru, but I do not know on what authority, and strongly doubt this record.

Von Ihering (1890) pointed out the differences from *A. riograndensis*, to which this species is closely allied. The original specimens of *A. forbesiana* were injured at the posterior end, and it was believed that in uninjured ones this end might be more strongly produced. However, Lea's figure shows in the growth-lines that the shape of the shell, before it was injured, was similarly truncated, and my series, which contains a majority of intact shells, demonstrates that the normal shape of this species also exhibits this truncation, *i.e.*, a steeply descending posterior margin. This is the chief character of this species, and in consequence, the dimensions are different from those of *A. riograndensis*.

This difference is seen first of all in the height, which varies from about 60 to 69 pr. et., falling under 60 pr. et. only in very young specimens, while in *riograndensis* it is from 54 to 63 pr. et. The diameter of the two species is about the same, but slightly higher on the average in *forbesiana* (35 to 48 pr. et. and in young ones as low as 33 pr. et. against 34 to 40 in *riograndensis*). The beaks of *forbesiana* are farther removed from the anterior end: 32 to 38 pr. et., against 29 to 33 pr. et. in *riograndensis*. Von Ihering gives the umbonal index as 48 pr. et., but this is due to his different method of measuring; measured in my specimens according to his method, it would be from 42 to 56 pr. et., while it is 34 to 43 pr. et. in *riograndensis*. The index above 50 pr. et. is found only in my youngest specimens, where the ligamental sinus is very anterior, thus making the hinge-line very short.

Finally, in *forbesiana*, the hinge-line is practically straight, as mentioned by Von Ihering, and represented in Lea's figure. This holds good in all of my specimens.

In other respects this species agrees with *riograndensis*, but it should be remarked that the radial scalariform stripes are generally absent or very poorly developed; only in one or two cases a few of them are distinctly seen on the anterior part of the shell.

MEASUREMENTS (SPECIMENS FROM URUGUAYANA).

No.	Sex.	Length.	Height.	Diameter.	Beaks.	Figured.
c. . .	♂(?)	29 mm.	16 mm. = 55 pr. et. of L.	9.5 mm. = 33 pr. et. of L.	at 10 mm. = 34 pr. et. of L.	
1. . .	♂	49 "	29 " = 59 "	17.5 " = 36 "	17 " = 35 "	
2. . .	♂	71 "	42.5 " = 60 "	25 " = 35 "	23 " = 32 "	
4. . .	♀	72 "	47 " = 65 "	28 " = 39 "	25.5 " = 35 "	
7. . .	♀	85 "	54.5 " = 64 "	36 " = 42 "	29 " = 34 "	
8. . .	♂	87 "	59 " = 68 "	42 " = 48 "	33 " = 38 "	Pl. XLIII, fig. 4.
10. . .	♂	100 "	69 " = 69 "	43 " = 43 "	37 " = 37 "	
11. . .	♀	108 "	70 " = 65 "	46 " = 43 "	38.5 " = 36 "	Pl. XLIV, fig. 3.
Lea's fig. . .		114 "	71 " = 62 "	54 " = 47 "	44 " = 38 "	

Simpson's measurements do not agree with these figures.

It should be noticed that young specimens are not so high, and also less swollen than older individuals, and thus the typical shape is less evident in them. They are also extremely thin-shelled, while older ones are rather solid.

*Anatomy*.—I have nine males and five females. The structure is exactly like that of *A. riograndensis*. The palpi have their posterior bases separated; for about two-thirds of their length the bases are contiguous, but then they diverge. The inner gill begins just without and close to the end of the inner palpus.

#### 64. ANODONTITES RIOPLATENSIS (SOWERBY) (1870).

*Anodon rioplatensis* SOWERBY, XVII, 1870, Pl. 26, fig. 101.

*Glabaris trapesialis rioplatensis* SIMPSON, 1900, p. 925.

*Anodontites trapesialis rioplatensis* SIMPSON, 1914, p. 1431.

*Type-locality*.—Rio de la Plata.

*Other Localities*.—Haas (1916, pp. 29, 54) mentions a closely related form from Rio Uruguay, Salto Oriental, Uruguay, which may, or may not, be this.

*New Locality*.—Rio Limay, Patagonia, Argentina (received in exchange from W. Israël). One specimen.

*Distribution*.—The Rio de la Plata and Rio Negro drainages in Argentina. Possibly also in Rio Uruguay.

We may regard this as an exaggerated *forbesiana*, with the shell higher and shorter, and the beaks more central, but in all other respects it is similar. Sowerby calls the shell thin, and describes concentric "wrinkles" on the beaks. Our specimen is rather solid, and the wrinkles are nothing but growth-lines.

MEASUREMENTS.

Length.	Height.	Diameter.	Beaks.	
108 mm.	82 mm. = 76 pr. ct. of L.	49.5 mm. = 46 pr. ct. of L.	at 43 mm. = 40 pr. ct. of L.	(my specimen)
106 "	76 " = 72 "			(Sowerby's figure)

#### Subgenus LAMPROSCAPHA Swainson (1840).

*Lamproscapha* SWAINSON, Treat. on Malacology, 1840, p. 381.

*Virgula* SIMPSON, 1900, p. 931; 1914, p. 1454.

Shell greatly elongated, knife-shaped, sharply pointed behind, with a sharp posterior ridge. Posterior retractor-scar completely separated from the adductor-scar, and remote from it by about one to three times its own diameter. Epidermis not shining, covered with very fine concentric (posteriorly) and radial scalari-form (anteriorly) wrinkles.

The greatly elongated shape and the posterior retractor-scar are evidently correlated characters. This subgenus apparently stands close to the *crispata*-group of *Anodontites* in the sculpture of the epidermis.

Swainson introduced *Lamproscapha* for four species, of which the first (*elongata* Swainson) was doubtfully referred here. The second is *ensiformis*. If the latter is to be separated from *Anodontites*, *Lamproscapha* is the oldest available name.

65. ANODONTITES (LAMPROSCAPHA) ENSIFORMIS (SPIX) (1827).

*Anodon ensiformis* SPIX & WAGNER, 1827, p. 31, Pl. 24, figs. 1, 2. SOWERBY, XVII, 1867, Pl. 11, fig. 31 (young).

*Anodonta ensiformis* D'ORBIGNY, 1843, p. 618, Pl. 79, fig. 10. VON IHERING, 1890, p. 161.

*Glabaris ensiformis* SIMPSON, 1900, p. 932.

*Anodontites ensiformis* SIMPSON, 1914, p. 1455. HAAS, 1916, pp. 36, 57.

*Type-locality* not given.

*Other Localities*.—Rio San Miguel (= Rio Itonama), Bolivia (tributary to Guaporé) (D'Orbigny); Rio Piray, Santa Cruz de la Sierra, Bolivia (tributary to Rio Marmoré, into which the Guaporé flows) (D'Orbigny); Rio Napo, Mazan, Peru (Haas). Repeatedly reported from Brazil, but no exact localities given.

Lea (Obs. XIII, 1874, p. 27) mentions this species as having been found in Guyana, in connection with a species from Yuruari River (tributary to Essequibo). Simpson (1900, p. 932 and 1914, p. 1456) describes a new species (*A. falsa*) taken by Lea for *ensiformis*, from the same river (Yuruari), "a branch of the Orinoco." The Yuruari, however, is a tributary of the Essequibo, but is located chiefly in Venezuela, not in Guyana, and does not belong to the Orinoco-system.

*New Locality*.—Rio Machupo, San Joaquín, Bolivia (tributary to Rio Itonama and Guaporé) (J. D. Haseman coll., September 5, 1909). Four specimens, three of them with soft parts. Another specimen is in the Carnegie Museum (from the Hartman collection) labeled "Brazil."

*Distribution*.—Definite localities are so far known only from the upper Amazon and Madeira drainages in Peru and Bolivia.

*Characters of the Shell*.—Shell moderately thick; outline much elongated, knife-like, pointed behind. Height 25 to 33 pr. et. of the length. Valves not gaping. Dorsal and ventral margins practically parallel, except towards the posterior end, where the dorsal margin curves in a gentle curve or a very obtuse angle into the posterior margin, which descends obliquely and is straight or gently concave. At the posterior end the margin curves sharply around to the ventral



margin, forming a blunt, but distinct point, which is hardly, or very little, elevated above the base-line. Lower margin almost straight, but with a more or less distinct concavity in the middle. Anteriorly the lower margin curves up into the rounded anterior margin.

Valves very slightly convex, practically flat upon the sides, and, in large specimens, even with a shallow depression corresponding to the concavity of the lower margin. The posterior ridge is distinct, but rounded, running towards the posterior-point of the shell. Above this ridge, the shell is somewhat compressed. Diameter 14 to 20 pr. et. of the length. Beaks low, and hardly elevated above the hinge-line, located at 18 to 26 pr. et. of the length, and proportionally more anterior in older specimens; the large specimen, described by D'Orbigny, has them at 15 pr. et. of the length.

Epidermis not smooth, with irregular concentric lines, heaviest upon the posterior ridge, and with very fine striae, sublamelliform upon the posterior slope and towards the margins. Faint radiating lines are present, dividing the fine striae into scalariform stripes of crowded, fine wrinkles, visible only in well-preserved specimens, and restricted to the anterior part of the shell. Color of epidermis greenish or brownish olive, inclining to blackish in old shells, without color-markings and without distinct growth-rests.

Hinge-line straight behind the beaks, slightly descending in front of them. Ligamental sinus much wider than deep, its anterior margin oblique to the hinge-line, but more nearly vertical in the largest specimen at hand.

Cavity of shell and beaks very shallow. Naere, in all of my specimens, whitish, but with blueish and purplish iridescence (according to other authors, it is sometimes coppery), with irregular radiating lines, most distinct towards the margins. Prismatic zone rather narrow, and subconcentric with the margin. Anterior adductor-scar well impressed, subovate. Anterior retractor-scar distinct, but connected with that of the adductor-scar. Anterior protractor-scar separated. Posterior adductor-scar faint, subovate. Posterior retractor-scar separated from the latter and rather removed from it, at least by as much as its own width; in old shells up to three times its width.

*Remarks.*—There can be no mistaking this species, the elongated shape being so characteristic, that no other South American form could be taken for it, with the possible exception of *A. falsa* (Simpson) from Venezuela (See above). It constitutes with the latter a peculiar group within the genus, but approaches the normal *Anodontites* (of the *crispata*-type) more than any other. The location

of the posterior retractor-scar is quite unique, but, of course, is connected with the elongated shape of the shell.

## MEASUREMENTS.

Locality.	No.	Length	Height.	Diameter.	Beaks.
S. Joaquim .....		35 mm.	10 mm. = 29 pr. ct. of L.	6 mm. = 17 pr. ct. of L.	at 9 mm. = 26 pr. ct. of L.
Do. .... 1	1	50 "	15 " = 30 "	10 " = 20 "	10 " = 20 "
Do. .... 2	2	55 "	14 " = 25 "	9 " = 16 "	11 " = 20 "
Do. .... 3	3	52 "	17 " = 33 "	10 " = 19 "	10 " = 19 "
"Brazil" .....	*	78 "	20 " = 26 "	12 " = 15 "	14 " = 18 "
D'Orbigny .....		130 "	= 29 "	= 19 "	= 15 " "
Simpson .....		97 "	25 " = 26 "	15 " = 15 "	
Do. .... 106	106	"	27 " = 25 "	15 " = 14 "	

*Anatomy.*—The soft parts of three specimens are at hand, but their sex is not positively known.

The structure is that of the genus *Anodontites*, with such modifications as are caused by the elongation of the shell. The mantle-connection between anal and branchial openings is a little longer than usual, the gills are extremely long and narrow, and the part behind the foot, where the two inner laminae of the inner gills are connected, is proportionally longer than in any other species. As indicated by the scars of the shell, the posterior retractor muscle is considerably removed from the adductor.

Anal opening entirely open. Branchial opening with very small papillae. Palpi comparatively long, but narrow, lower margins forming a gentle curve. Posteriorly they are very briefly truncated, forming the posterior margins, which are not connected. Structure of gills as usual, with distinct septa. I have not been able to positively identify the sex of the three specimens at hand: the condition of the gills is rather unsatisfactory, they being much torn, so that no sections could be made, and from macroscopical examination (and with a lens) no indications of a differentiation of the inner gills could be detected: this, indeed, would indicate the male sex, but my specimens are too young for one to be sure about this. The inner gill, as usual begins immediately behind the palpi, and the inner lamina of the inner gill is entirely connected with the abdominal sac. Foot rather long, but altogether small; of course, the real shape could not be made out on account of the contraction in alcohol.

## Genus MYCETOPODA D'Orbigny (1835).

Simpson, 1914, p. 1457.

Characterized by very elongated, subtrapezoidal shell, which is widely gaping in front. The chief characters, however, are in the soft parts. The foot is ex-

tremely elongated and dilated at the end (button-like), and probably is in life never entirely withdrawn into the shell (hence the gaping margins). In addition, the branchial opening is said to be closed below (Simpson), but I have not been able to confirm this, and furthermore the pallial line does not show any indication of this (having no sinus). D'Orbigny makes the positive statement that the branchial is not closed. The anal opening is closed in part.

This genus has a wide distribution in South America, from the Cordilleras eastward, and from Argentina northwards into Central America, at least as far as Guatemala.

Von Ihering has given a key for the species (1910, p. 118); although this is not always quite satisfactory, I have used it in the identification of my comparatively meagre material. Von Ihering's treatment of the genus surely has cleared up a good deal, but it is not to be regarded as final. His opinion that there are species of this genus in Eastern Asia (*Solenais*) certainly is incorrect. We do not know the anatomical structure of the latter, except that the foot is said to be similarly developed. But we must not forget, that there is a North American *Unionid*-shell (*Lastena lata*), which also has a foot like this. In the muscle-sears, the ligamental sinus, and the beak-sculpture *Solenais* undoubtedly differs from the South American *Mycetopoda*, which according to the anatomy is a *Muteline*-shell.

The species (*subsiniata*) of which I have studied the anatomy, has another character, the partly closed anal-opening, in which it differs from all South American *Muteline*, and resembles the African members of this subfamily. This may be another peculiar feature of the genus, but it is desirable that other species should be examined as to this.

#### 66. MYCETOPODA SILIQUOSA (SPIX) (1827).

*Mycetopoda siliquosa* VON IHERING, 1910, p. 120; SIMPSON, 1914, p. 1458.

*Mycetopoda bahia* VON IHERING, 1910, p. 122, Pl. 12, fig. 3; SIMPSON, 1914, p. 1463.

According to Simpson, *M. legumen* (Von Martens) and *M. clessini* Von Ihering belong here.

*Type-locality*.—Rio Paraguassú, Bahia, Brazil.

*Other Localities*.—Rio Piracicaba, Piracicaba, São Paulo, Brazil (Von Ihering, 1893); Rio São Francisco, Villa Nova, Sergipe (not Bahia), Brazil (Von Ihering, *M. bahia*).

*New Locality*.—Lagoa Salgado, Bahia, Brazil (upper Rio Salitré, tributary to São Francisco) (J. D. Haseman coll., November 10, 1907). Two specimens. Two

other specimens are in the Carnegie Museum, without exact localities, from the Holland and Juny collection respectively.

*Distribution*.—Restricted to eastern Brazil, to the drainages of the Rio Paraná in São Paulo, and of the Rio Paraguassú and Rio São Francisco in Bahia and Sergipe. Possibly more widely distributed in the São Francisco system.

Haas (1916, p. 37, 58) gives this species also from Rio Unuyacu (tributary to Rio Napo) in Ecuador; however, he conceived it in Simpson's sense, and we cannot be sure that it is *M. siliquosa* as defined by Von Ihering.

My specimens fully agree with the account given by Von Ihering, and their measurements come very close to those given by him.

#### MEASUREMENTS.

Locality.	Length.	Height.	Diameter.	Beaks.
Lagoa Salgado . . . . .	72 mm.	26 mm. = 36 pr. ct. of L.	13.5 mm. = 17 pr. ct. of L.	at 19 mm. = 26 pr. ct. of L.
Holland coll. . . . .	80 "	29.5 " = 37 "	15 " = 19 "	20 " = 25 "
Juny coll. . . . .	85.5 "	31 " = 36 "	15 " = 18 "	21 " = 25 "
Lagoa Salgado . . . . .	89 "	35 " = 39 "	20 " = 22 "	27 " = 30 "
Spix' type . . . . .	80 "	31 " = 39 "		22 " = 28 "

The figures for Spix' type are taken from Von Ihering (1890). Von Ihering (1910, in the key) gives the location of the beaks as ranging from 18 to 29 pr. ct. and the height as ranging from 35 to 37 pr. ct. of the length.

*Remarks*.—In all of my specimens, the posterior adductor scar is presinual. *M. bahia* is founded upon a single specimen, which has the measurements: L. 78, H. 27 = 35 pr. ct., D. 15.5 = 20 pr. ct., beaks at 23 = 30 pr. ct. These figures fall within the range of variation of *M. siliquosa*. In Von Ihering's key there is here a weak point, since the forms are distinguished chiefly by the location of the beaks, with the figures partly overlapping. I cannot find any difference in *bahia* from *siliquosa*, except that the lower margin in the former ascends slightly behind, and that the posterior adductor scar is said to be "subsinal, in part even a little presinual." The first character very well may be individual; the second, disregarding the fact that it is hard to understand, does not at all differ from *siliquosa*, where this scar is simply presinual. Indeed, my young specimen from Lagoa Salgado has the adductor-scar less in advance of the ligamental sinus than the larger. Altogether, this young specimen is extremely close to *bahia*, only the posterior lower margin is not curved up, and the beaks are more anterior. It is also remarkable for the great thinness and transparency of the shell. Therefore I think that *M. bahia* is only a young individual of *M. siliquosa*.

## 67. MYCETOPODA STAUDINGERI (VON IHERING) (1890).

*Myctopus staudingeri* VON IHERING, 1890, p. 130, figs. A, B.

*Myctopoda staudingeri* SIMPSON, 1900, p. 934; VON IHERING, 1910, p. 121.

*Myctopoda siliquosa staudingeri* SIMPSON, 1914, p. 1460.

*Type-locality*.—Rio Huayabamba, Peru (tributary to Rio Huallaga).

*Additional Locality*.—Rio Huallaga, Peru (Von Ihering).

*Locality Represented in Carnegie Museum*.—Marañon, Upper Amazon (Hartman collection). One specimen.

*Distribution*.—Headwaters of the Amazon in Peru; a variety (*aequatorialis* Von Ihering) in Ecuador.

Our specimen agrees very well with Von Ihering's description and figures, chiefly with fig. A (which is supposed to be a male) but it to a certain degree stands between figs. A and B (See measurements of height). The postsinual position of the posterior adductor-scar is evident and remarkable, and it seems, indeed, that this is an important taxonomic character. The posterior end of the upper margin (behind the ligamental sinus) is in my specimen not so greatly elevated as in Von Ihering's figures.

## MEASUREMENTS.

	Length.	Height.	Diameter.	Beaks.
My specimen . . . . .	94 mm.	38 mm. = 40 pr. et. of L.	19 mm. = 20 pr. et. of L.	at 24 mm. = 25 pr. et. of L.
Von Ihering, A . . . . .	93 "	35 " = 38 "	" "	
Do. , B . . . . .	103 "	43 " = 42 "	21 " = 20 "	

In 1910, Von Ihering gives for the height 35 to 37 pr. et. of the length, which does not exactly agree with his original figures. The location of the beaks is according to him is 27 to 28 pr. et. of the length.

## 68. MYCETOPODA SUBSINUATA (SOWERBY) (1868).

*Myctopus subsinuatus* SOWERBY, XVI, 1868, Pl. 4, fig. 10; VON MARTENS, 1900, p. 540, Pl. 41, fig. 5.

*Myctopoda subsinuata* SIMPSON, 1900, p. 934; VON IHERING, 1910, p. 120; SIMPSON, 1914, p. 1461.

*Type-locality*.—Bogota, Colombia.

*Other Localities*.—Ecuador (Von Ihering); Paso Antonio, West Guatemala (Pacific slope) (Von Martens).

*New Localities*.—Marañon, Upper Amazon (Peru) (Hartman coll.). Three complete specimens, four left valves. Rio Conchins, Maya Farm, Quirigua, Guatemala (Atlantic slope, to Rio Montagua) (A. A. Hinkley coll., February 6,

1913). One shell, female, with soft parts, and soft parts of a male and female without shells.

*Distribution*.—From the upper Amazon drainage in Peru and Ecuador through Colombia into Central America, northward to Guatemala, where it is found both on the Atlantic and Pacific slopes.

Von Ihering's key has failed me in the identification of this species, since he uses size as a criterion, while my specimens are all rather small. The height, also used as a distinctive character, is apparently unreliable, as shown by my specimens. Therefore this group (*hh* in the key) needs revision.

Nevertheless the two largest specimens at hand (one from the upper Amazon, the other from Guatemala) agree fairly well with Von Ihering's account and measurements, and also with those of Von Martens. There is no question about the identity of the Central American specimens with the form from northern South America. The posterior adductor-scar is said to be subsinual (Von Ihering p. 118). This fits my smaller specimens from the upper Amazon, while the larger one is peculiar. It appears as if there were in each valve two superimposed scars, the one more anterior, the other a little farther back. The latter is superficial, but apparently corresponds to the latest growth-addition to the shell. Its anterior end is slightly in advance of the ligamental sinus (presinual). In this specimen, however, there is a disturbance of the regular growth, as indicated by a strong growth-rest on the outside of the shell, and the shell looks as if stunted behind. This individual is therefore not normal. In the large specimen from Guatemala, the scar is also slightly presinual (about one-third of the retractor-process projecting in front of the sinus), and in Von Martens' figure (representing a very large specimen) this scar is still more presinual.

The sinuosity of the lower margin is seen in my two larger specimens, but is not so strong as in Sowerby's and Von Martens' figures. The young specimens, which undoubtedly belong with the larger one, show hardly a trace of this sinuosity.

## MEASUREMENTS.

Locality.	No.	Sex.	Length.	Height.	Diameter.	Beaks.
Marañon .....	1	?	58 mm.	17 mm. = 29 pr. et. of L.	10 mm. = 17 pr. et. of L.	at 15 mm. = 26 pr. et. of L.
Do. ....	2	?	63 "	19 " = 30 "	10 " = 16 "	17 " = 27 "
Do. ....	3	?	75 "	23 " = 31 "	12 " = 16 "	20 " = 27 "
Do. ....	4	?	75 "	23 " = 31 "	12 " = 16 "	20 " = 27 "
Guatemala.....	5	♀	86 "	28 " = 33 "	17.5 " = 20 "	21.5 " = 25 "
Marañon.....	5	?	(88) "	31 " = (35 " )	20 " = (23 " )	26 " = (30 " )
Sowerby.....			118 "	41 " = 35 "		
Von Martens.....			125 "	43 " = 34 "	23 " = 18 "	
Do. ....			132 "	45 " = 34 "	23 " = 17 "	29 " = 32 "

My specimen, No. 5, from the Marañon is the one, which probably is injured, and the length probably would be greater, when normal; this, of course, has influence on the other indices, which are all somewhat too high. The figures taken from Sowerby and Von Martens are close to mine. The greater height undoubtedly is due to the larger size of the specimens, and probably also to the more anterior location of the beaks.

*Anatomy.*—Soft parts of one male and two females at hand, one of the latter is gravid (collected February 6).

The anatomy is that of the South American *Muteline*, but it resembles that of the African *Muteline*, in having the anal opening closed above for about half of its length. The opening is therefore comparatively short, being only a little longer than the branchial opening, and reaching upward only to about the middle of the adductor muscles. In other South American *Muteline* it reaches upward beyond the posterior retractor-muscles. The anal is separated from the branchial opening by a connection of the mantle; its inner edge is smooth. Branchial opening with fine papillæ on the inner edge. Although Simpson says that the branchial opening is closed below, I cannot find any trace of a mantle-connection at the lower (anterior) end. There is also no indication that such a connection has been torn during life, or in preservation. Palpi long and low, their lower margins curved, not drawn out into a posterior point, posteriorly with a short truncation, forming the posterior margins, which are not connected.

Foot very large, subcylindrical and subcompressed, at the distal end swollen into a button-like knob. This structure is likewise not seen in other *Muteline* shells.

Gills long and narrow, the inner the wider, the anterior ends as usual. Inner lamina of inner gill entirely connected with abdominal sac. Distinct, continuous septa of the *Muteline* type are present. The inner gill of the female is *marsupial*, with thicker, but not more crowded, septa; the water-tubes are again divided by vertical ridges into an inner and outer compartment, the inner of which serves as ovisac, the outer as secondary water-canal. Eggs small, loosely hanging together. I have not been able to find mature larvæ in my gravid female.

#### Genus LEILA Gray (1840).

Simpson, 1914, p. 1399.

The chief character of this genus is the sinus of the pallial line below the posterior adductor-scar, which is said to be connected with the closing of the branchial opening at its lower (anterior) end, but particulars about this are not known.

In other respects the shell of this genus is very similar to that of the species

of the *trapesialis*-group of *Anodontites*, with which it also has in common the gaping margins. A peculiar character, generally missing in South American *Mutelinæ*, is the presence of an oblique row of dorsal muscle-sears in the beak-cavity.

There can be hardly any question that this genus represents a more highly specialized type of the genus *Anodontites*, and that its root is in the *trapesialis*-group. Its distribution extends over South America, east of the Andes, and from the basin of the Amazon southward to northern Argentina.

The genus *Leila* is in great confusion, although there seem to exist only a few species. Its revision has been attempted by Von Ihering (1890, p. 39) and by Simpson, (1900, p. 914), but these two authors have arrived at very different conclusions. Both agree in recognizing two groups: the one containing species with a practically straight hinge-line (*L. blainvilliana* and *L. spixi*), the other species with a curved or sinuate hinge-line. While Simpson unites all of the forms belonging to the latter group, into one species (*L. esula*), Von Ihering distinguishes three as valid.

My material is entirely insufficient to permit me to decide this point. The specimens before me unquestionably come under *L. castelnaudi* Hupé, and so I shall record them under this name, without attempting to pass upon the question whether then are different from *esula* D'Orbigny and from *pulvinata* Hupé. They also agree fairly well with Von Ihering's description of *castelnaudi*.

#### 69. LEILA CASTELNAUDI HUPÉ (1857).

*Leila castelnaudi* HUPÉ, 1857, p. 91, Pl. 19, fig. 1.

*Anodon castelnaudi* SOWERBY, XVII, 1868, Pl. 20, fig. 79.

*Columba castelnaudi* VON IHERING, 1890, pp. 139, 142.

According to Simpson (1914, p. 1401) this is identical with *L. esula* (D'Orbigny).

*Type-locality*.—"Bourbon ou Olympo, Paraguay." This probably is Fuerte Olympo, on Rio Paraguay, northern Paraguay.

*New Localities*.—Rio Paraguay, Corumbá, Matto Grosso, Brazil (H. H. Smith coll.). One left valve. Swamp of Lambaré, Asunción, Paraguay (J. D. Haseman coll., March 31, 1909). One left valve.

#### MEASUREMENTS.

Locality.	Length.	Height.		Diameter.	Beaks.	Hinge-line.	
V. Ihering	138 mm.	96 mm. = 70 pr.ct. of L.				105 mm. = 76 pr.ct. of L.	
Asunción .	158 "	112 "	= 71 "	88 mm. = 43 pr. ct. of L.	at 48 mm. = 30 pr. ct. of L.	101 "	= 64 "
Corumbá .	166 "	116 "	= 70 "	70 "	= 42 "	52 "	= 31 "
						114 "	= 69 "

Von Ihering has measured according to a peculiar method, but I see no par-



ticular advantage in this. Yet the length of the hinge-line from its anterior end to the anterior end of the ligamental sinus, and its proportion to the length of the shell, should be noted, because there are slight differences in our specimens in this respect.

According to Hupé's figure, the beaks are located at 44 mm. = 32 pr. et. of length. This and the height given by Von Ihering agree very well with my specimens, but the proportion of the hinge-line to the total length is less in the latter. But the figures for my specimens show that there is variation in this respect.

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(Note: As to the authorship of the species described by Spix and Wagner, Cf. Von Ihering, 1890, pp. 118-119, footnote).

## EXPLANATION OF PLATE XXXIV.

SHELLS OF *DIPLODON HASEMANI* ORTMANN AND *DIPLODON IMITATOR* ORTMANN.

All figures natural size.

FIGS. 1-4. *Diplodon hasemani* Ortmann, from Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil. Carn. Mus. Cat. No. 61.5857.

FIG. 1a. Adult male (No. 10), lateral view.

FIG. 1b. Adult male (No. 10), dorsal view.

FIG. 2a. Adult, gravid female (No. 9), lateral view.

FIG. 2b. Adult, gravid female (No. 9), inner view of left valve.

FIG. 2c. Adult, gravid female (No. 9), inner view of right valve.

FIG. 3. Half-grown, gravid female (No. 4), lateral view.

FIG. 4. Young, gravid female (No. x), lateral view.

FIGS. 5-7. *Diplodon imitator* Ortmann, from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.9248. (See also Pl. XXXV, figs. 1 and 2).

FIG. 5a. Half-grown male (No. 29), lateral view.

FIG. 5b. Half-grown male (No. 29), inner view of left valve.

FIG. 5c. Half-grown male (No. 29), inner view of right valve.

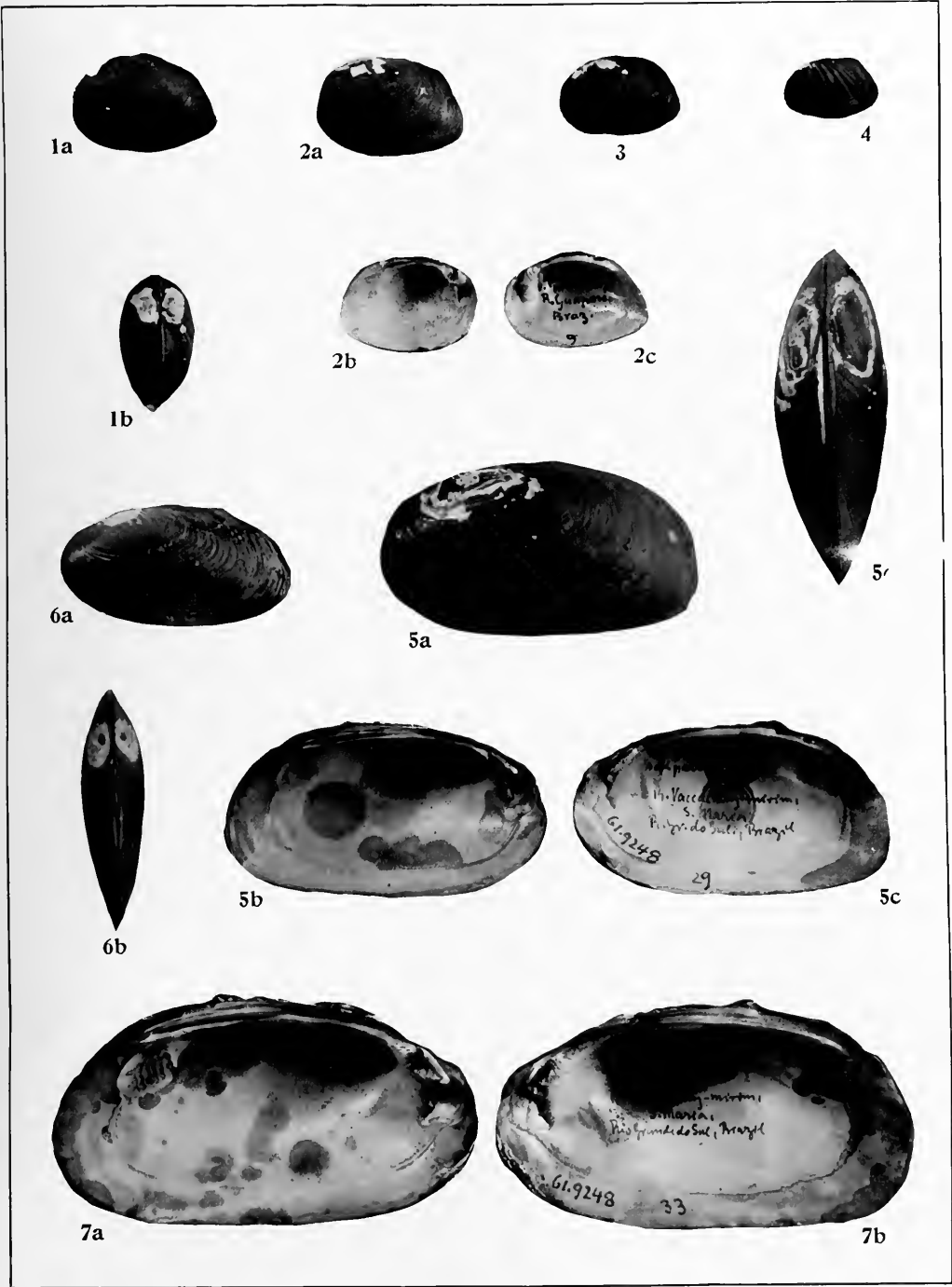
FIG. 5d. Half-grown male (No. 29), dorsal view.

FIG. 6a. Young male (No. 14), lateral view.

FIG. 6b. Young male (No. 14), dorsal view.

FIG. 7a. Adult female (No. 33), inner view of left valve (see also Pl. XXXV, fig. 1).

FIG. 7b. Adult female (No. 33), inner view of right valve.



DIPLODON.





## EXPLANATION OF PLATE XXXV.

SHELLS OF DIPLODON IMITATOR ORTMANN, DIPLODON SIMILLIMUS ORTMANN, AND  
DIPLODON VICARIUS ORTMANN.

All figures natural size.

FIGS. 1 AND 2. *Diplodon imitator* Ortmann, from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.9248 (See also Pl. XXXIV, figs. 5-7).

FIG. 1. Adult female (No. 33), lateral view (same specimen as that figured on Pl. XXXIV, fig. 7).

FIG. 2. Young, gravid female (No. 21), lateral view.

FIGS. 3-6. *Diplodon simillimus* Ortmann, from Rio Nhundiaquara, Morretes, Paraná, Brazil. Carn. Mus. Cat. No. 61.9250.

FIG. 3. Half-grown male (No. 11), lateral view.

FIG. 4. Half-grown male (No. 16), lateral view.

FIG. 5a. Adult, gravid female (No. 22), lateral view.

FIG. 5b. Adult, gravid female (No. 22), dorsal view.

FIG. 5c. Adult, gravid female (No. 22), inner view of left valve.

FIG. 5d. Adult, gravid female (No. 22), inner view of right valve.

FIG. 6a. Young, gravid female (No. 24), lateral view.

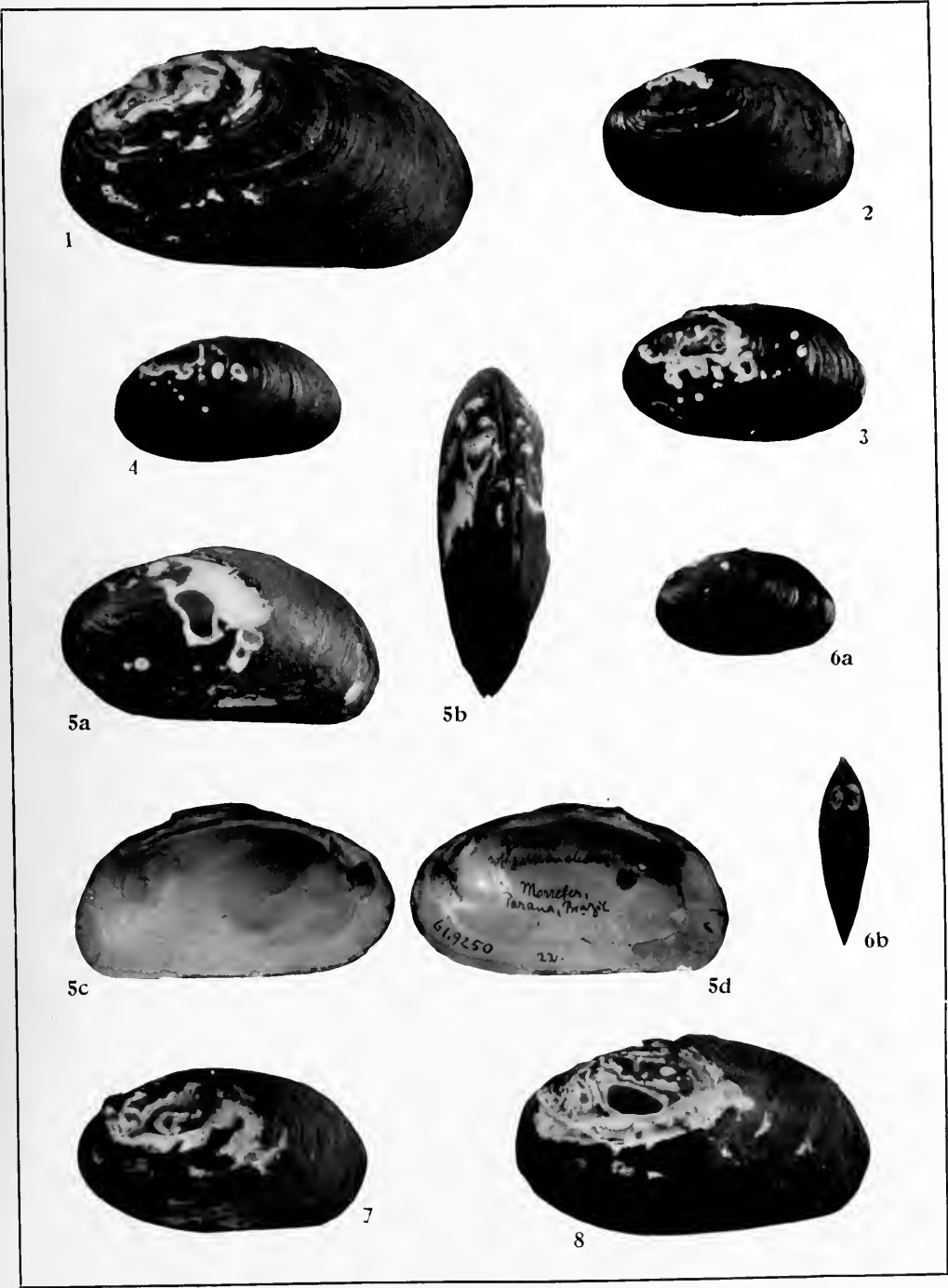
FIG. 6b. Young, gravid female (No. 24), dorsal view.

FIGS. 7 AND 8. *Diplodon vicarius* Ortmann, from creek (Rio Ribeira drainage), Aqua Quente, near Iporanga, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9251 (See also Pl. XXXVI, figs. 1 and 2).

FIG. 7. Half-grown male (No. 13), lateral view.

FIG. 8. Adult female (No. 15), lateral view (See also Pl. XXXVI, fig. 1).





DIPLODON.





## EXPLANATION OF PLATE XXXVI.

SHELLS OF *DIPLODON VICARIUS* ORTMANN, *DIPLODON DECIPIENS* ORTMANN, AND  
*DIPLODON HILDE* ORTMANN.

All figures natural size.

FIGS. 1 AND 2. *Diplodon vicarius* Ortmann, from creek (Rio Ribeira drainage), Aqua Quente, near Iporanga, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9251 (See also Pl. XXXV, figs. 7 and 8).

FIG. 1a. Adult female (No. 15), dorsal view (same specimen as that figured on Pl. XXXV, fig. 8).

FIG. 1b. Adult female (No. 15), inner view of left valve.

FIG. 1c. Adult female (No. 15), inner view of right valve.

FIG. 2. Half-grown, gravid female (No. 9), lateral view.

FIGS. 3-6. *Diplodon decipiens* Ortmann, from creek (tributary to Rio Iguassú), Serrinha, Paraná, Brazil. Carn. Mus. Cat. No. 61.9253.

FIG. 3a. Adult male (No. 4), lateral view.

FIG. 3b. Adult male (No. 4), inner view of left valve.

FIG. 3c. Adult male (No. 4), inner view of right valve.

FIG. 3d. Adult male (No. 4), dorsal view.

FIG. 4. Adult female (No. 6), lateral view.

FIG. 5. Half-grown, gravid female (No. 3), lateral view.

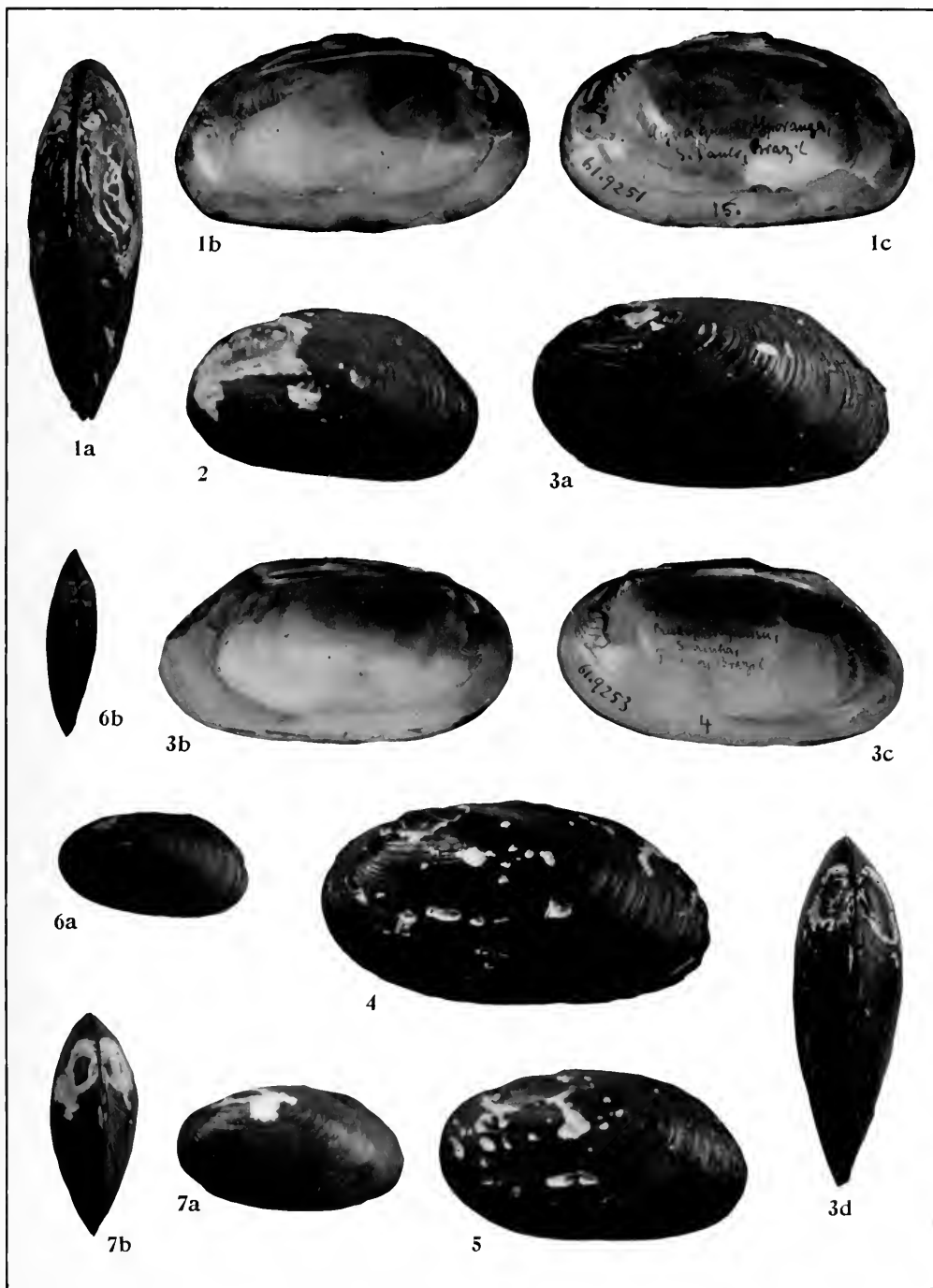
FIG. 6a. Young female (No. e), lateral view.

FIG. 6b. Young female (No. e), dorsal view.

FIG. 7. *Diplodon hilde* Ortmann, from Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5864 (See also Pl. XXXVII, figs. 1-3).

FIG. 7a. Nearly full grown male (No. q), lateral view.

FIG. 7b. Nearly full grown male (No. q), dorsal view.







## EXPLANATION OF PLATE XXXVII.

SHELLS OF *DIPLODON HILDE* ORTMANN AND *DIPLODON MOGYMIRIM* ORTMANN.

All figures natural size.

FIGS. 1-3. *Diplodon hilde* Ortmann, from Rio Jacuby, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5864 (See also Pl. XXXVI, fig. 7).

FIG. 1a. Young male (No. d), lateral view.

FIG. 1b. Young male (No. d), dorsal view.

FIG. 2a. Adult female (No. 15), lateral view.

FIG. 2b. Adult female (No. 15), dorsal view.

FIG. 2c. Adult female (No. 15), inner view of left valve.

FIG. 2d. Adult female (No. 15), inner view of right valve.

FIG. 3. Half-grown female (No. b), lateral view.

FIGS. 4-7. *Diplodon mogymirim* Ortmann, from creek (tributary to Rio Mogy Guassú), Mogy Mirim, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9260.

FIG. 4a. Adult male (No. 22), lateral view.

FIG. 4b. Adult male (No. 22), inner view of left valve.

FIG. 4c. Adult male (No. 22), inner view of right valve.

FIG. 5a. Half-grown male (No. 9), lateral view.

FIG. 5b. Half-grown male (No. 9), dorsal view.

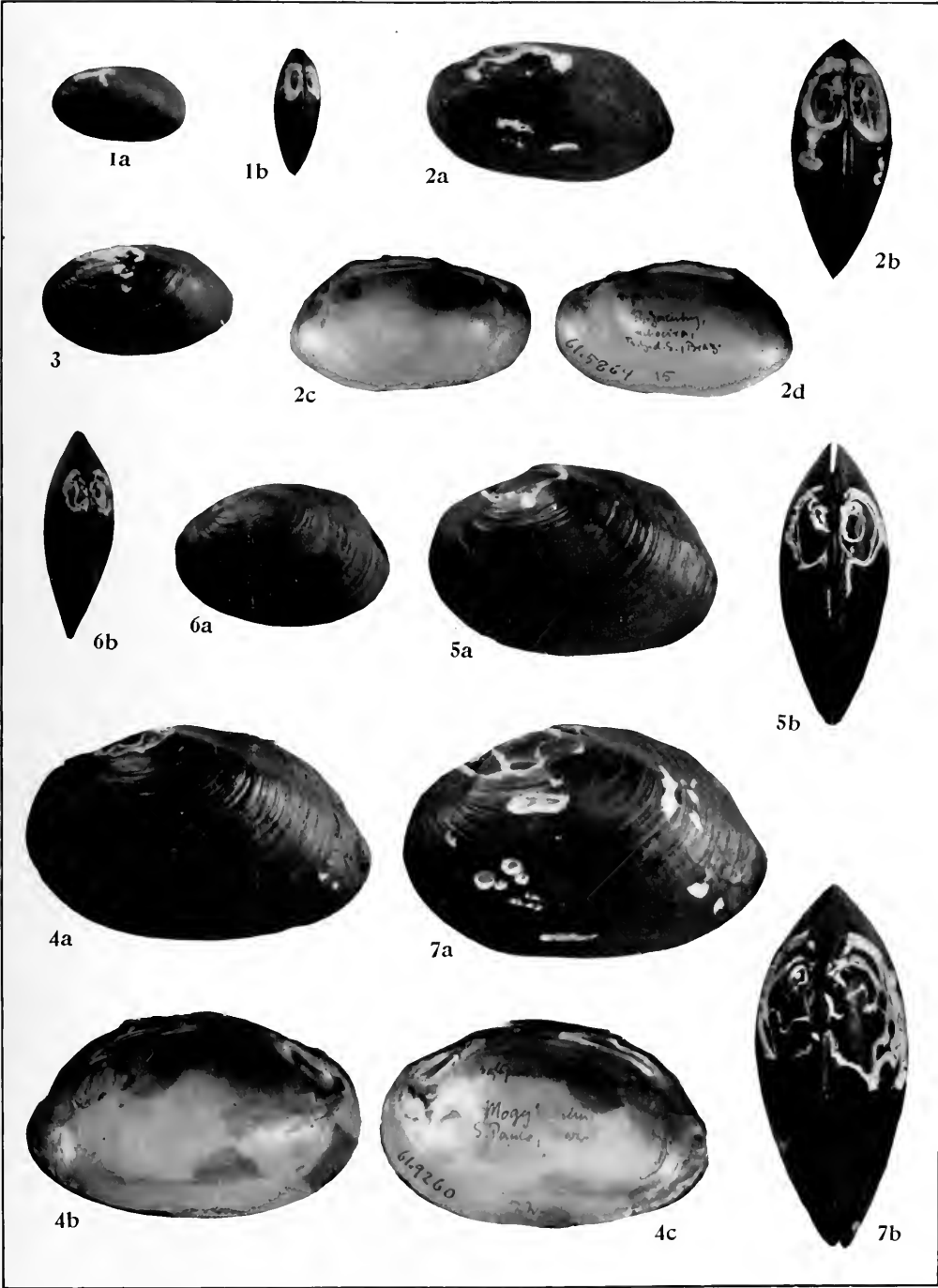
FIG. 6a. Young male (No. 12), lateral view.

FIG. 6b. Young male (No. 12), dorsal view.

FIG. 7a. Adult female (No. 3S), lateral view.

FIG. 7b. Adult female (No. 3S), dorsal view.





DIPLODON.





## EXPLANATION OF PLATE XXXVIII.

SHELLS OF *DIPLODON BERTHÆ* ORTMANN AND *DIPLODON ENNO* ORTMANN.

All figures natural size.

FIGS. 1-4. *Diplodon berthæ* Ortmann, from Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5865.

FIG. 1a. Adult male (No. 24), lateral view.

FIG. 1b. Adult male (No. 24), dorsal view.

FIG. 1c. Adult male (No. 24), inner view of left valve.

FIG. 1d. Adult male (No. 24), inner view of right valve.

FIG. 2a. Young male (No. 3), lateral view.

FIG. 2b. Young male (No. 3), dorsal view.

FIG. 3a. Gravid female (No. 10), lateral view.

FIG. 3b. Gravid female (No. 10), dorsal view.

FIG. 4. Gravid female (No. 16), lateral view.

FIGS. 5-8. *Diplodon enno* Ortmann, from Rio Grande (São Francisco drainage), Boqueirão, Bahia, Brazil. Carn. Mus. Cat. No. 61.9264.

FIG. 5. Half-grown male (No. 4), lateral view.

FIG. 6a. Young male (No. 12), lateral view.

FIG. 6b. Young male (No. 12), dorsal view.

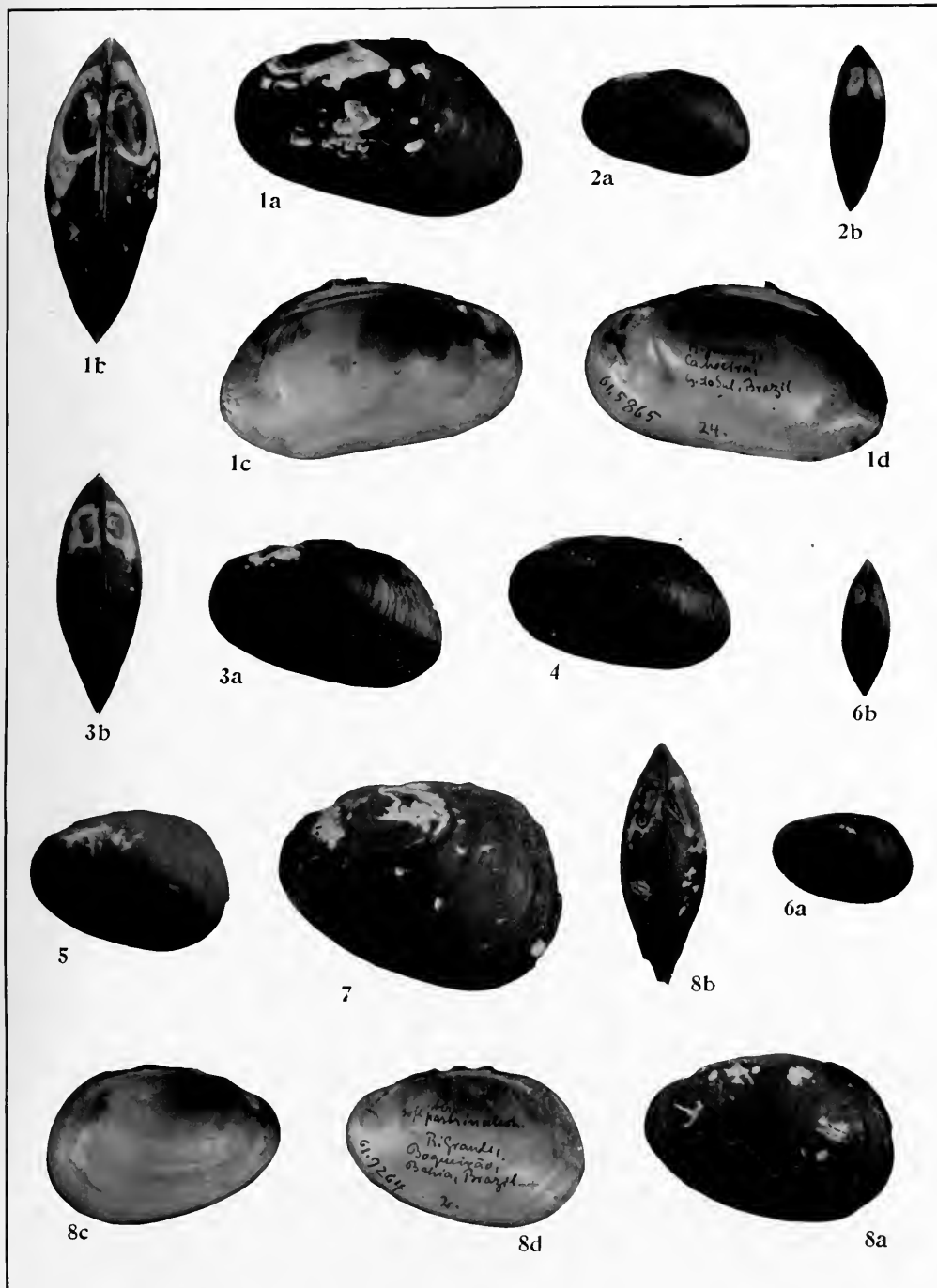
FIG. 7. Adult female (No. 1), lateral view.

FIG. 8a. Nearly adult female (No. 2), lateral view.

FIG. 8b. Nearly adult female (No. 2), dorsal view.

FIG. 8c. Nearly adult female (No. 2), inner view of left valve.

FIG. 8d. Nearly adult female (No. 2), inner view of right valve.







## EXPLANATION OF PLATE XXXIX.

SHELLS OF *DIPLODON DECEPTUS* (SIMPSON), *DIPLODON (CYCLOMYA) PARANENSIS* (LEA),  
AND *CASTALIA UNDOSA* VON MARTENS.

All figures natural size.

FIGS. 1-5. *Diplodon deceptus* (Simpson), from Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5868.

FIG. 1a. Adult male (No. 10), lateral view.

FIG. 1b. Adult male (No. 10), dorsal view.

FIG. 1c. Adult male (No. 10), inner view of left valve.

FIG. 1d. Adult male (No. 10), inner view of right valve.

FIG. 2. Adult male (No. 11), lateral view.

FIG. 3. Half-grown male (No. 4), lateral view.

FIG. 4. Half-grown female (No. 6), lateral view.

FIG. 5a. Young specimen (sex ?) (No. 2), lateral view.

FIG. 5b. Young specimen (sex ?) (No. 2), dorsal view.

FIGS. 6 AND 7. *Diplodon (Cyclomya) parancensis* (Lea).

FIG. 6. Nearly adult female (No. a), lateral view, from Rio de la Plata, San Isidro, Argentina. Carn. Mus. Cat. No. 61.9265.

FIG. 7. Young specimen, lateral view, from Rio Paraguay, Corumba, Matto Grosso, Brazil. Carn. Mus. Cat. No. 61.2031.

FIG. 8. *Castalia undosa* Von Martens, from Rio Tieté, Itapura, São Paulo, Brazil. Carn. Mus. Cat. No. 61.5116.

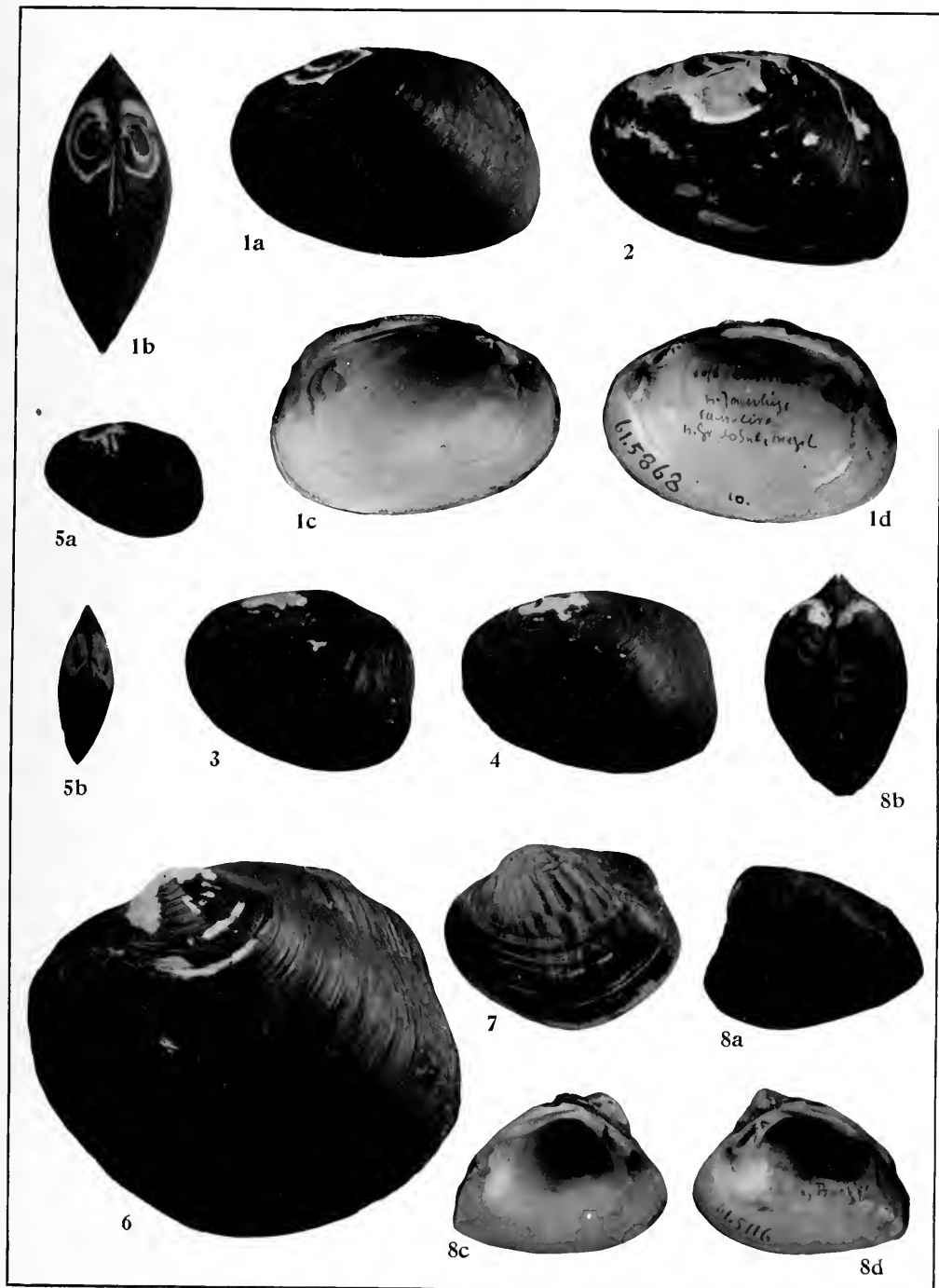
FIG. 8a. Half-grown specimen, lateral view.

FIG. 8b. Half-grown specimen, dorsal view.

FIG. 8c. Half-grown specimen, inner view of left valve.

FIG. 8d. Half-grown specimen, inner view of right valve.





DIPLODON and CASTALIA.





## EXPLANATION OF PLATE XL.

SHELLS OF *PRISODON ALATUS* (SOWERBY), *MONOCONDYLÆA OBESA* ORTMANN, AND  
*ANODONTITES CRISPATA* BRUGUIÈRE.

All figures natural size.

FIGS. 1-3. *Prisodon alatus* (Sowerby), from Rio Tapajos, Santarem, Para, Brazil.  
Carn. Mus. Cat. No. 61.5109.

FIG. 1. Adult specimen, lateral view.

FIG. 2*a*. Half-grown specimen, lateral view.

FIG. 2*b*. Half-grown specimen, dorsal view.

FIG. 2*c*. Half-grown specimen, inner view of left valve.

FIG. 2*d*. Half-grown specimen, inner view of right valve.

FIG. 3. Young specimen, lateral view.

FIGS. 4-6. *Monocondylæa obesa* Ortmann, from Rio Tapajos, Santarem, Para,  
Brazil. Carn. Mus. Cat. No. 61.5850.

FIG. 4*a*. Half-grown specimen (No. 10), lateral view.

FIG. 4*b*. Half-grown specimen (No. 10), inner view of left valve.

FIG. 4*c*. Half-grown specimen (No. 10), inner view of right valve.

FIG. 5*a*. Young specimen (No. 5), lateral view.

FIG. 5*b*. Young specimen (No. 5), dorsal view.

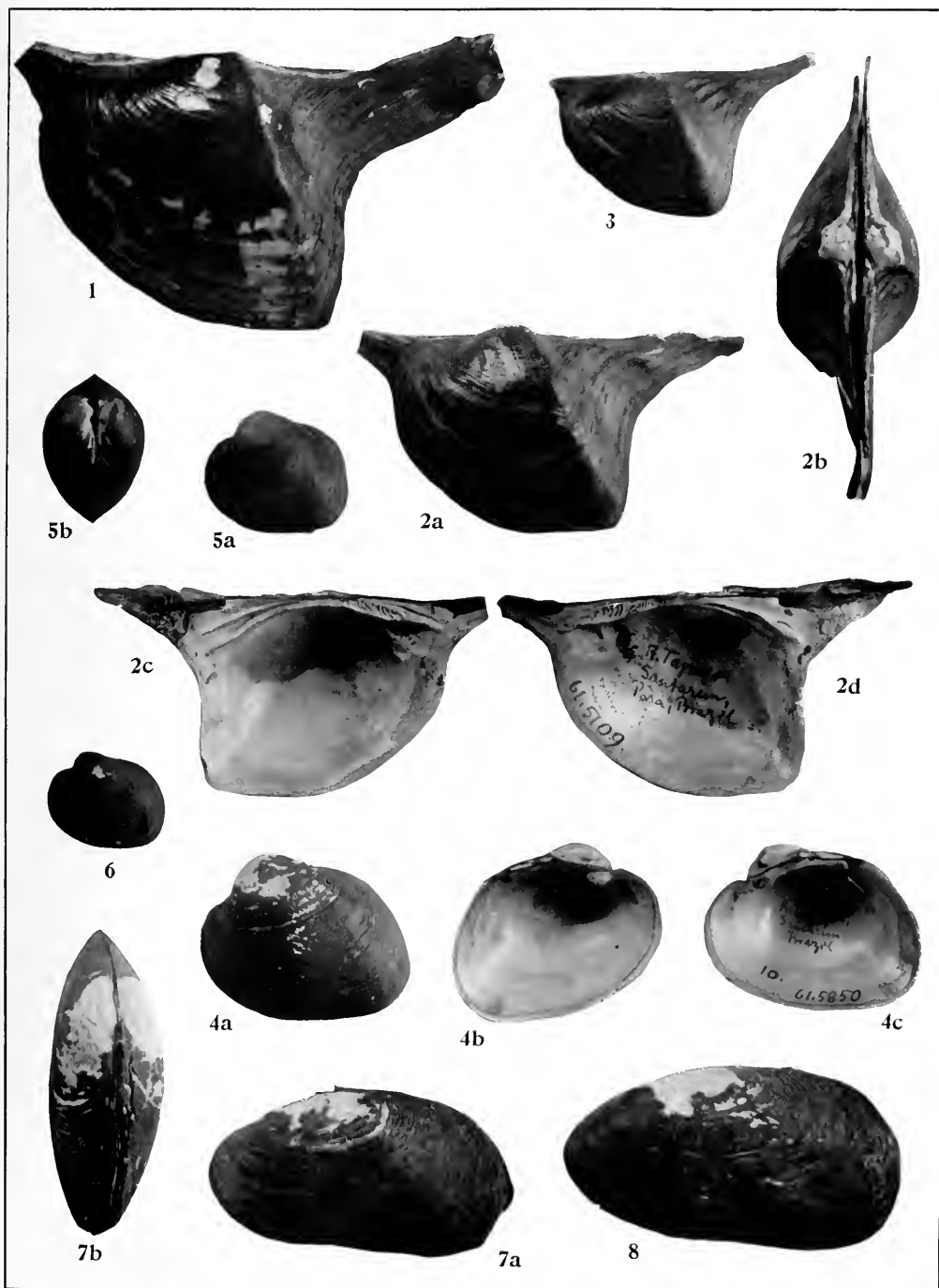
FIG. 6. Young specimen (No. 1), lateral view.

FIGS. 7 AND 8. *Anodontites crispata* Bruguière, from Rio de la Paila, Paila, U. S.  
of Colombia. Carn. Mus. Cat. No. 61.9274 (See also Plate XLI, figs. 2 and 3).

FIG. 7*a*. Half-grown male (No. 8), lateral view.

FIG. 7*b*. Half-grown male (No. 8), dorsal view.

FIG. 8. Nearly adult female (No. 10), lateral view.



PRISODON, MONOCONDYLEA, ANODONTITES.





## EXPLANATION OF PLATE XLI.

SHELLS OF *MONOCONDYLAEA HOLLANDI* ORTMANN, *ANODONTITES CRISPATA* BRUGIÈRE,  
AND *ANODONTITES CLESSINI* (FISCHER).

All figures natural size.

FIG. 1. *Monocondylaea hollandi* Ortmann, from Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil. Carn. Mus. Cat. No. 61.5846.

FIG. 1a. Holotype, male, lateral view.

FIG. 1b. Holotype, male, dorsal view.

FIG. 1c. Holotype, male, inner view of right valve.

FIGS. 2 AND 3. *Anodontites crispata* Bruguière, from Rio de la Paila, Paila, U. S. of Colombia. Carn. Mus. Cat. No. 61.9274 (See also Plate XL, figs. 7 and 8).

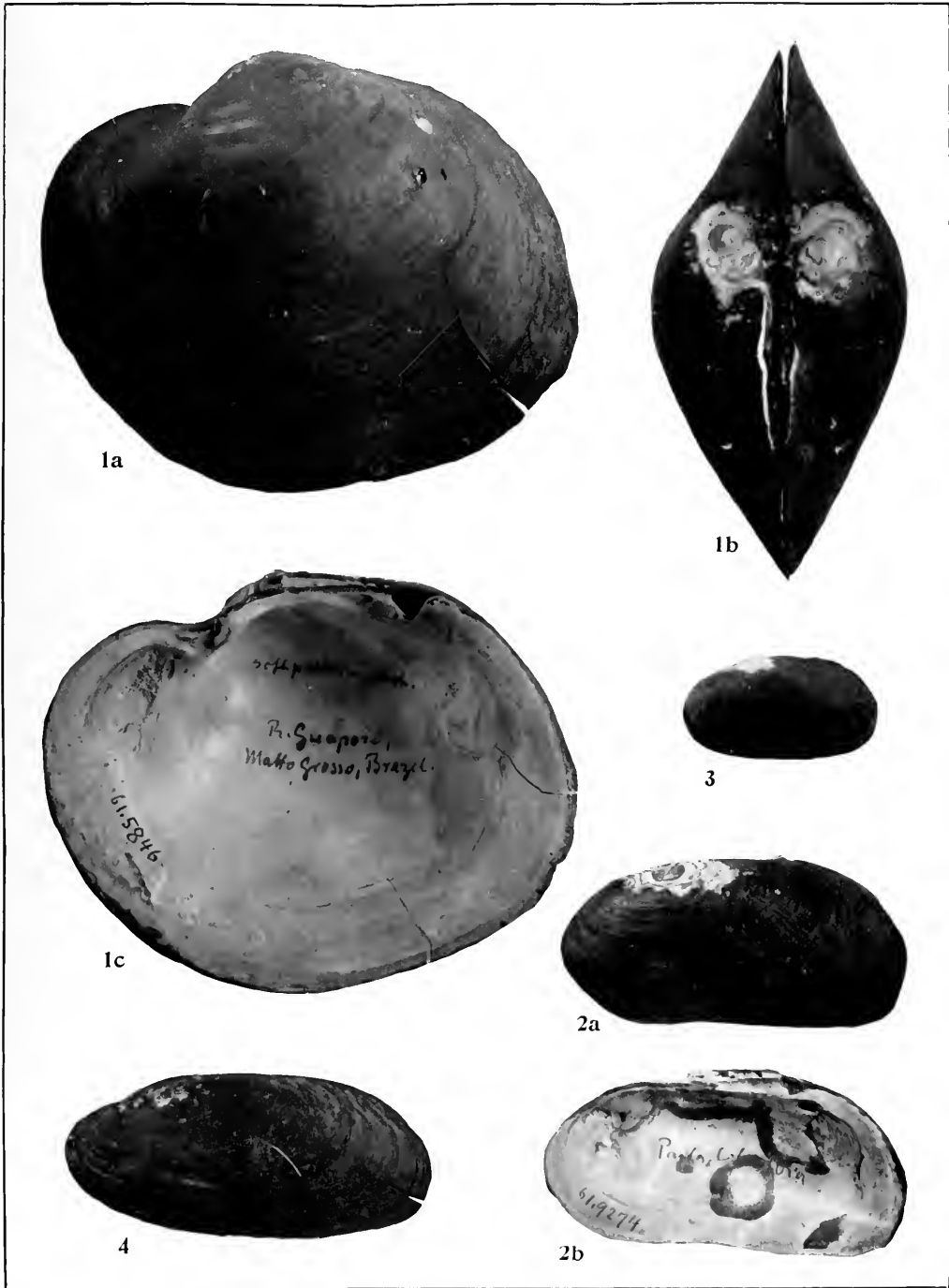
FIG. 2a. Nearly adult specimen (sex ?), lateral view.

FIG. 2b. Nearly adult specimen (sex ?), inner view of right valve.

FIG. 3. Young specimen (sex ?), lateral view.

FIG. 4. *Anodontites clessini* (Fischer), from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5820 (See also Plate XLII, figs. 1 and 2). Male (No. 12), lateral view (See also Plate XLII, fig. 1).





MONOCONDYLEA, ANODONTITES.





## EXPLANATION OF PLATE XLII.

SHELLS OF *ANODONTITES CLESSINI* (FISCHER), *ANODONTITES HYRIOIDES* ORTMANN,  
*ANODONTITES HASEMANI* ORTMANN, AND *ANODONTITES IHERINGI* (CLESSIN).

All figures natural size.

FIGS. 1 AND 2. *Anodontites clessini* (Fischer), from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5820 (See also Plate XLI, fig. 4).

FIG. 1. Male (No. 12), dorsal view (Same specimen as that figured on Pl. XLI, fig. 4).

FIG. 2a. Female (No. 11), lateral view.

FIG. 2b. Female (No. 11), inner view of right valve.

FIGS. 3-5. *Anodontites hyrioides* Ortmann, from Rio Tapajos, Santarem, Para, Brazil. Carn. Mus. Cat. No. 61.5829.

FIG. 3a. Largest specimen (No. 6), lateral view.

FIG. 3b. Largest specimen (No. 6), inner view of right valve.

FIG. 4a. Half-grown specimen (No. 4), lateral view.

FIG. 4b. Half-grown specimen (No. 4), dorsal view.

FIG. 5. Young specimen (No. 1), lateral view.

FIGS. 6 AND 7. *Anodontites hasemani* Ortmann, from Rio Paraguay, Santa Rita, Matto Grosso, Brazil. Carn. Mus. Cat. No. 61.5832.

FIG. 6a. Half-grown male (No. 1), lateral view.

FIG. 6b. Half-grown male (No. 1), inner view of left valve.

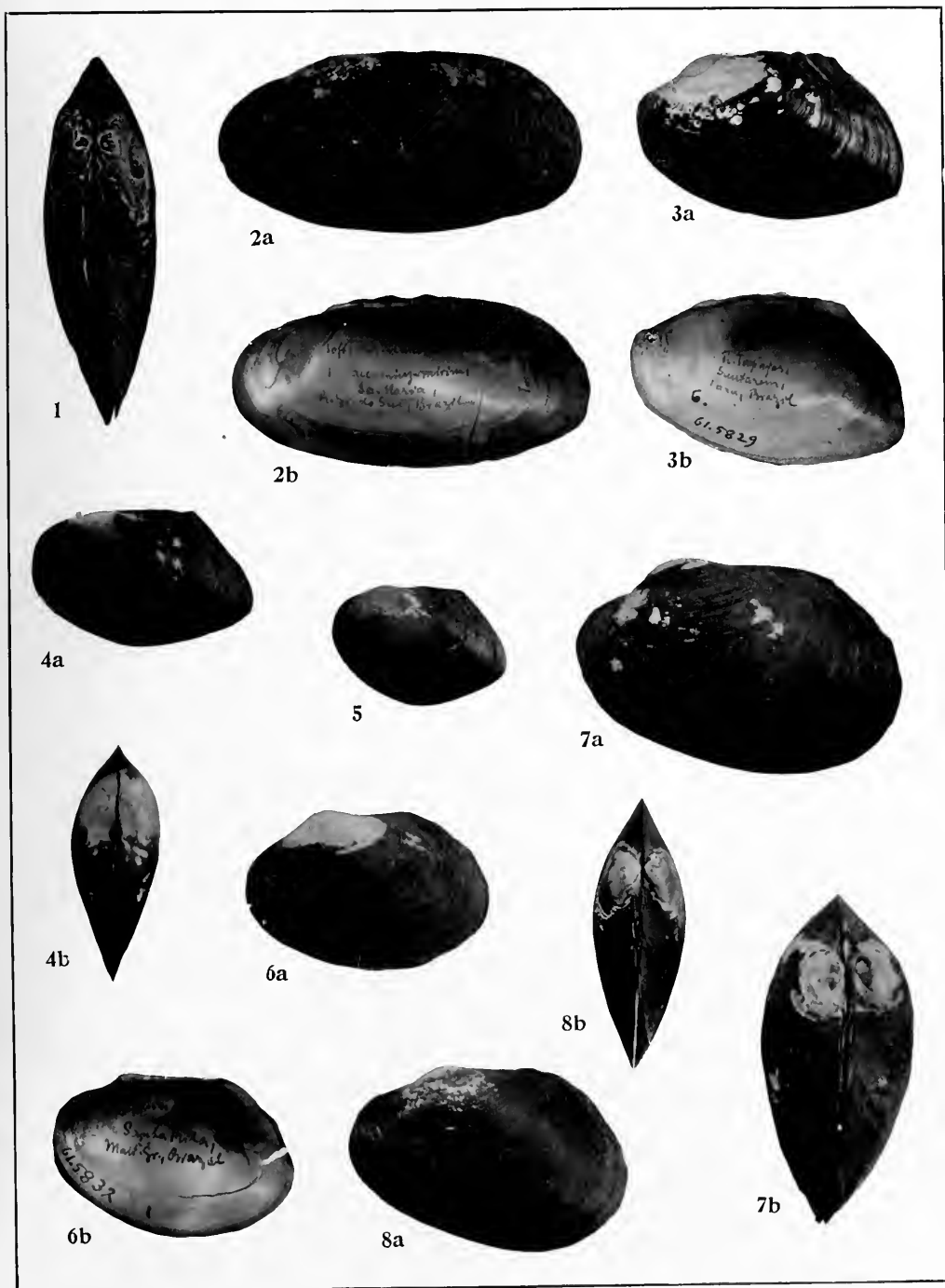
FIG. 7a. Gravid female (No. 3), lateral view.

FIG. 7b. Gravid female (No. 3), dorsal view.

FIG. 8. *Anodontites iheringi* (Clessin), from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5815 (See also Plate XLIII, fig. 1, and Plate XLIV, fig. 1).

FIG. 8a. Half-grown male (No. 1), lateral view.

FIG. 8b. Half-grown male (No. 1), dorsal view.



ANODONTITES.





## EXPLANATION OF PLATE XLIII.

SHELLS OF *ANODONTITES IHERINGI* (CLESSIN), *ANODONTITES RIOGRANDENSIS* (VON IHERING), AND *ANODONTITES FORBESIANA* (LEA).

All figures natural size.

FIG. 1. *Anodontites iheringi* (Clessin), from Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5815 (See also Plate XLII, fig. 8, and Plate XLIV, fig. 1).

Adult female (No. 3), lateral view (See also Plate XLIV, fig. 1).

FIGS. 2 AND 3. *Anodontites riograndensis* (Von Ihering), from Rio de la Plata, San Isidro, Argentina. Carn. Mus. Cat. No. 61.9279 (See also Plate XLIV, fig. 2).

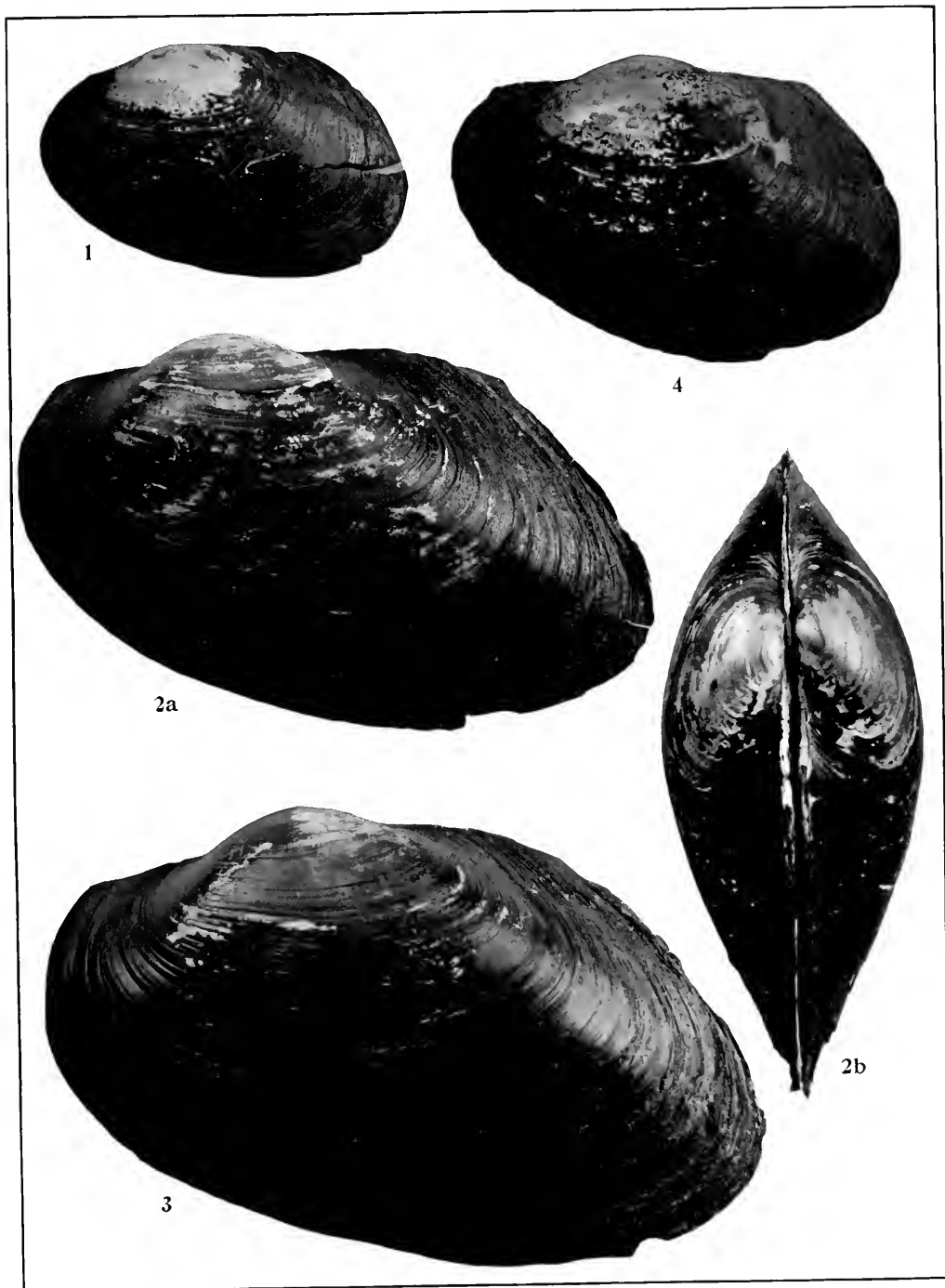
FIG. 2a. Adult male (No. x), lateral view.

FIG. 2b. Adult male (No. x), dorsal view.

FIG. 3. Adult, gravid female (No. z), lateral view (See also Plate XLIV, fig. 2).

FIG. 4. *Anodontites forbesiana* (Lea), from Rio Uruguay, Uruguayana, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.9280 (See also Plate XLIV, fig. 3). Half-grown male (No. 8), lateral view.





ANODONTITES.





## EXPLANATION OF PLATE XLIV.

SHELLS OF *ANODONTITES IHERINGI* (CLESSIN), *ANODONTITES RIOGRANDENSIS* (VON IHERING), AND *ANODONTITES FORBESIANA* (LEA).

All figures natural size.

FIG. 1. *Anodontites iheringi* (Clessin), from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5815 (See also Plate XLII, fig. 8, and Plate XLIII, fig. 1). Adult female (No. 3), inner view of right valve (Same specimen as that figured on Plate XLIII, fig. 1).

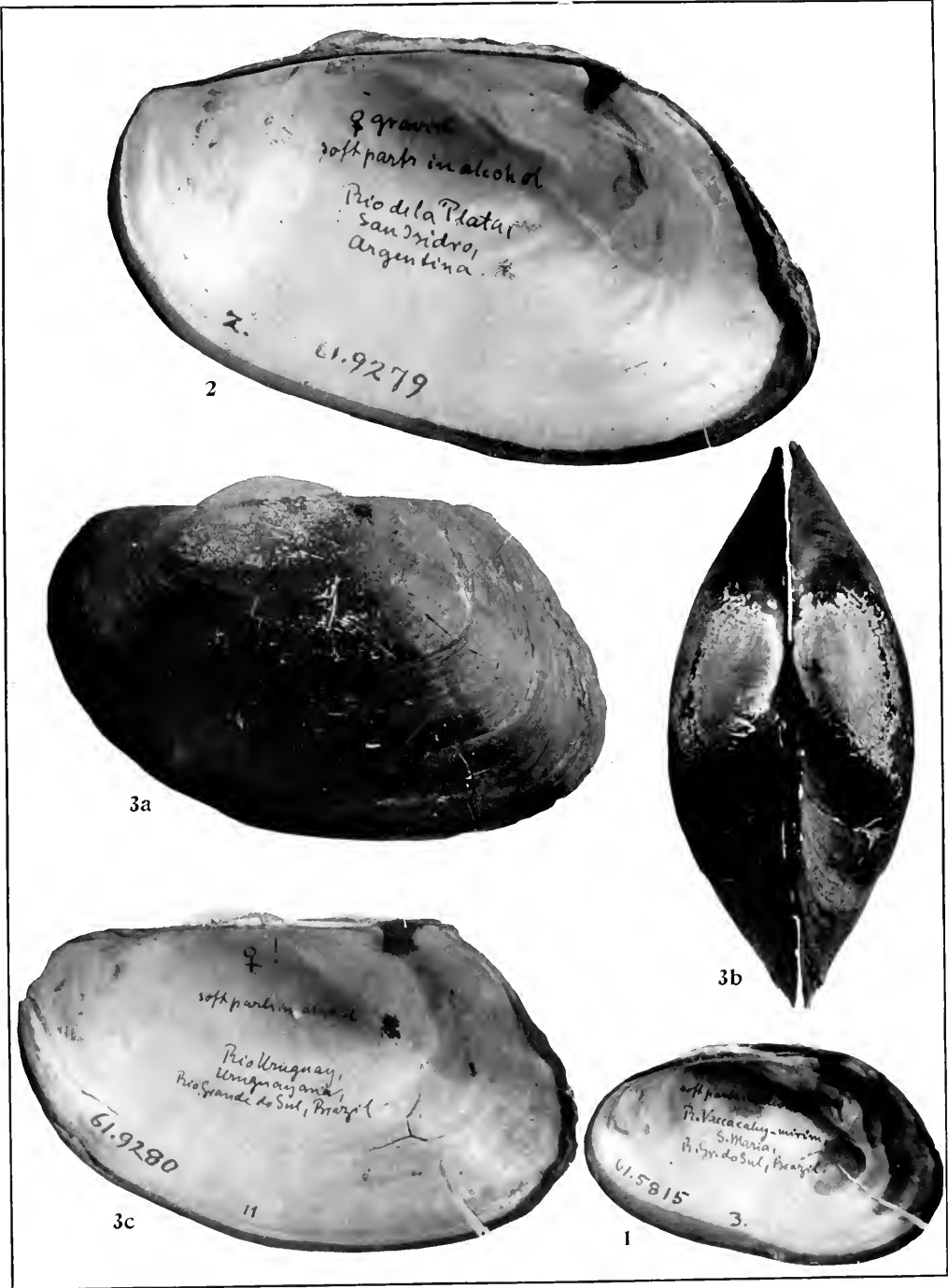
FIG. 2. *Anodontites riograndensis* (Von Ihering), from Rio de la Plata, San Isidro, Argentina, Carn. Mus. Cat. No. 61.9279 (See also Plate XLIII, figs. 2 and 3). Adult, gravid female (No. z), inner view of right valve (Same specimen as that figured on Plate XLIII, fig. 3).

FIG. 3. *Anodontites forbesiana* (Lea), from Rio Uruguay, Uruguayana, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.9280 (See also plate XLIII, fig. 4).

FIG. 3a. Nearly adult female (No. 11), lateral view.

FIG. 3b. Nearly adult female (No. 11), dorsal view.

FIG. 3c. Nearly adult female (No. 11), inner view of right valve.



ANODONTITES.





## EXPLANATION OF PLATE XLV.

GILLS OF *DIPLODON IMITATOR* ORTMANN, *DIPLODON SIMILLIMUS* ORTMANN, *DIPLODON VICARIUS* ORTMANN, AND *DIPLODON DECIPIENS* ORTMANN.

All figures represent the left gills magnified to twice natural size, the inner gill to the left, the outer gill to the right.

FIG. 1. *Diplodon imitator* Ortmann, from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.9248.

FIG. 1a. Gills of male (No. 29) (Shell of this specimen figured on Plate XXXIV, fig. 5).

FIG. 1b. Gills of female (No. 32).

FIG. 2. *Diplodon simillimus* Ortmann, from Rio Nhundiaquara, Morretes, Paraná, Brazil. Carn. Mus. Cat. No. 61.9250.

FIG. 2a. Gills of male (No. 7).

FIG. 2b. Gills of female (No. 23).

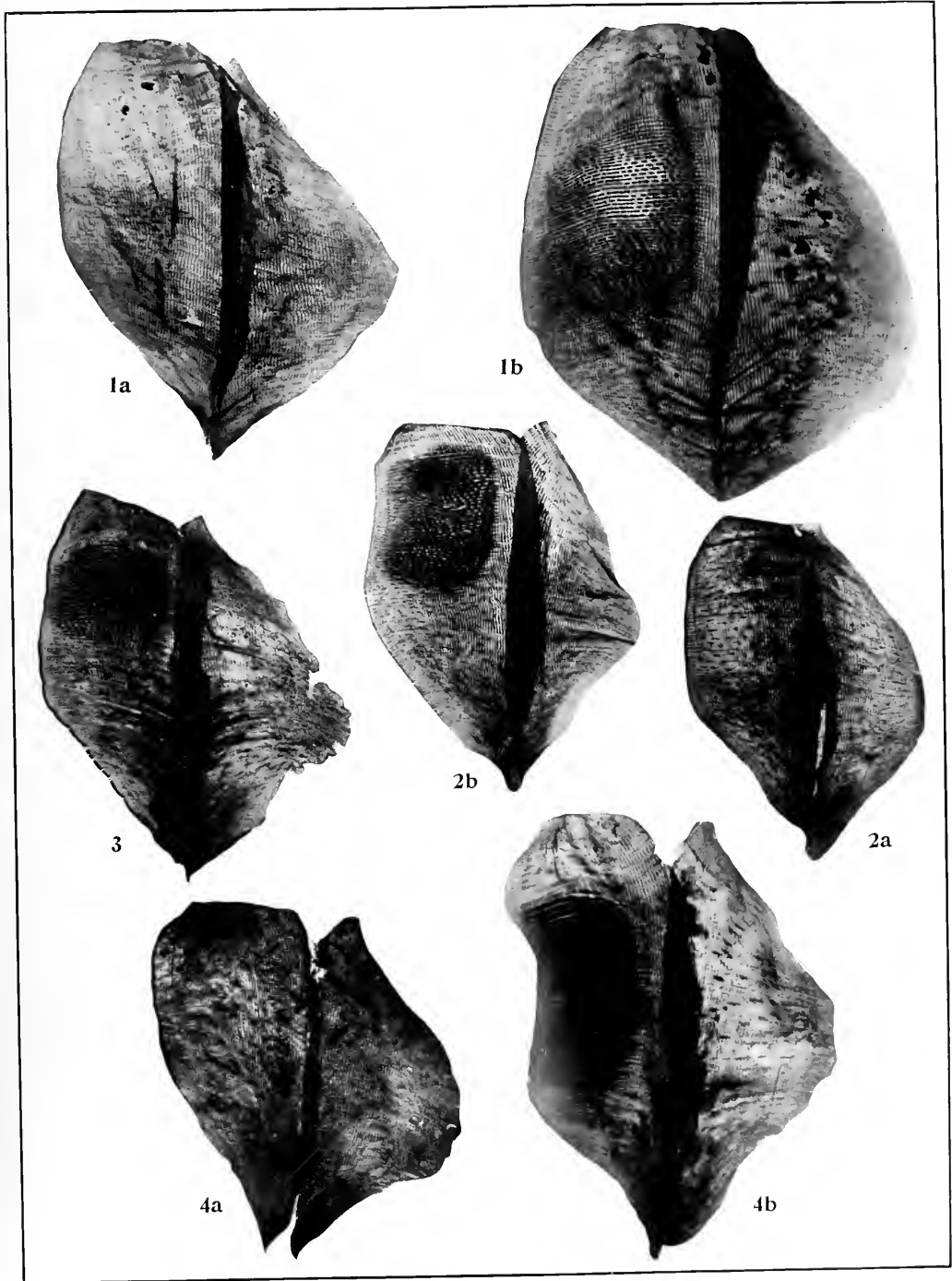
FIG. 3. *Diplodon vicarius* Ortmann, from creek (Rio Ribeira drainage), Aqua Quente, near Iporanga, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9251. Gills of female (No. 14).

FIG. 4. *Diplodon decipiens* Ortmann, from creek (tributary to Rio Iguassú), Serrinha, Paraná, Brazil. Carn. Mus. Cat. No. 61.9253.

FIG. 4a. Gills of male (No. 2).

FIG. 4b. Gills of female (No. 6) (Shell of this specimen figured on Plate XXXVI, fig. 4).





ANATOMY OF DILODON.





## EXPLANATION OF PLATE XLVI.

GILLS OF *DIPLODON PAULISTA* (VON IHERING), *DIPLODON PICEUS* (LEA), *DIPLODON HILDE ORTMANN*, *DIPLODON BURROUGHIANUS* (LEA), *DIPLODON MOGYMIRIM* ORTMANN, *DIPLODON BERTHE ORTMANN*, AND *DIPLODON ENNO ORTMANN*.

All figures represent left gills magnified to twice natural size, the inner gill to the left, the outer gill to the right.

FIG. 1. *Diplodon paulista* (Von Ihering), from Rio Tieté, Mogy das Cruzes, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9294. Gills of female (No. 4).

FIG. 2. *Diplodon piceus* (Lea), from Rio Uruguay, Uruguayana, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5862. Gills of female (No. 7).

FIG. 3. *Diplodon hilde* Ortmann, from Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5864. Gills of female (No. 15) (Shell of this specimen figured on Plate XXXVII, fig. 2).

FIG. 4. *Diplodon burroughianus* (Lea), from pond along Rio Negro, Santa Isabel, Uruguay. Carn. Mus. Cat. No. 61.5859. Gills of female (No. x).

FIG. 5. *Diplodon mogymirim* Ortmann, from creek (tributary to Rio Mogy Guassú) Mogy Mirim, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9260.

FIG. 5a. Gills of male (No. 28).

FIG. 5b. Gills of young female (No. 18).

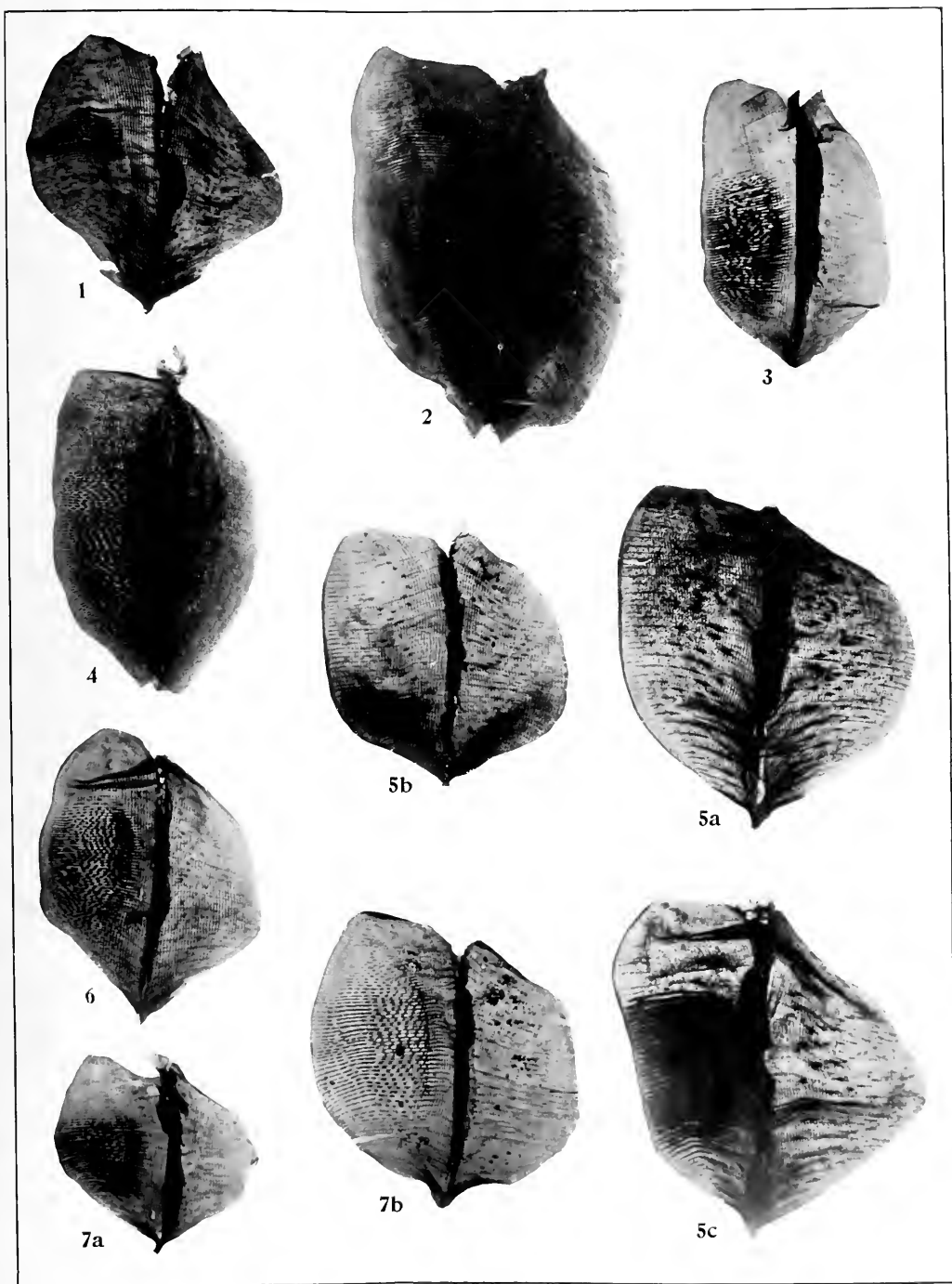
FIG. 5c. Gills of adult female (No. 44).

FIG. 6. *Diplodon berthæ* Ortmann, from Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5865. Gills of female (No. 21).

FIG. 7. *Diplodon enno* Ortmann, from Rio Grande (São Francisco drainage), Boqueirão, Bahia, Brazil. Carn. Mus. Cat. No. 61.9264.

FIG. 7a. Gills of young female (No. 7).

FIG. 7b. Gills of nearly adult female (No. 2) (Shell of this specimen figured on Plate XXXVIII, fig. 8).



ANATOMY OF DIPLODON.





## EXPLANATION OF PLATE XLVII.

LEFT GILLS OF *DIPLODON DECEPTUS* (SIMPSON), *CASTALLA NEHRINGI* VON IHERING,  
AND RIGHT GILLS OF *MONOCONDYLÆA LENTIFORMIS* LEA AND *ANODONTITES*  
*CLESSINI* (FISCHER); twice natural size; inner gill to the left,  
outer gill to the right (Figs. 1-4).

HORIZONTAL SECTIONS OF GILLS OF *DIPLODON HASEMANI* ORTMANN, *DIPLODON IMITATOR*  
ORTMANN, AND *DIPLODON DECIPiens* ORTMANN; much enlarged; inner  
gill to the left, outer gill to the right (Figs. 5-7).

FIG. 1. *Diplodon deceptus* (Simpson), from Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. 61.5868. Gills of female (No. 9).

FIG. 2. *Castalina nehringi* Von Ihering, from Rio Tieté, Itapura, São Paulo, Brazil. Carn. Mus. Cat. No. 61.5120. Gills of half-grown female (No. 1).

FIG. 3. *Monocondylæa lentiformis* Lea, from Rio Uruguay, Uruguayana, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5841.

FIG. 3a. Gills of male (No. 1).

FIG. 3b. Gills of female (No. 4).

FIG. 4. *Anodontites clessini* (Fischer), from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5820.

FIG. 4a. Gills of male (No. 12) (Shell of this specimen figured on Plate XLI, fig. 4, and Plate XLII, fig. 1).

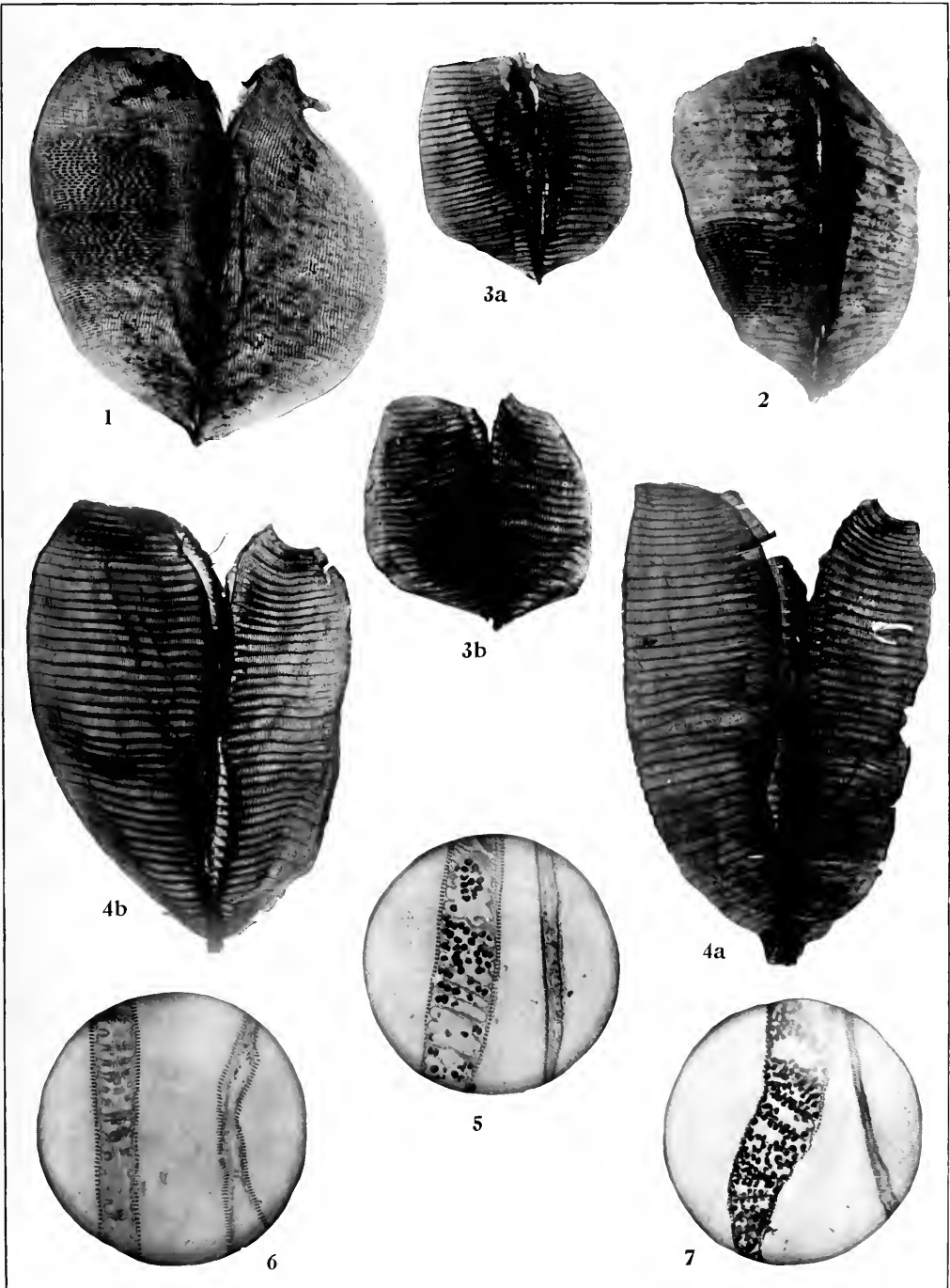
FIG. 4b. Gills of female (No. 11) (Shell of this specimen figured on Plate XLII, fig. 2).

FIG. 5. *Diplodon hasemani* Ortmann, from Rio Guaporé, near Rio São Simão, Matto Grosso, Brazil, Carn. Mus. Cat. No. 61.5857. Section of gills of gravid female (No. 5).

FIG. 6. *Diplodon imitator* Ortmann, from Rio Vaccahy-mirim, Santa Maria, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.9284. Section of gills of female (No. 33) (Shell of this specimen figured on Plate XXIV, fig. 7).

FIG. 7. *Diplodon decipiens* Ortmann, from creek (tributary to Rio Iguassú), Serinha, Paraná, Brazil. Carn. Mus. Cat. No. 61.9253. Section of gills of gravid female (No. 5).





ANATOMY OF DIPLODON, CASTALIA, MONOCONDYLEA, ANODONTITES.





## EXPLANATION OF PLATE XLVIII.

HORIZONTAL SECTIONS OF GILLS OF *DIPLODON PAULISTA* (VON IHERING), *DIPLODON MOGYMIRIM* ORTMANN, *DIPLODON GRATUS* (LEA), *DIPLODON DECEPTUS* (SIMPSON), *CASTALINA NEHRINGI* VON IHERING, *FOSSULA FOSSICULIFERA* (D'ORBIGNY), *MONOCONDYLEA MINUANA* D'ORBIGNY, AND *ANODONTITES PATAGONICA RUBICUNDA* (LEA);

much enlarged; inner gill to the left,  
outer gill to the right.

FIG. 1. *Diplodon paulista* (Von Ihering), from creek (tributary to Rio Mogy Guassú), Mogy Mirim, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9256. Section of gills of gravid female (No. 3).

FIG. 2. *Diplodon mogymirim* Ortmann, from creek (tributary to Rio Mogy Guassú), Mogy Mirim, São Paulo, Brazil. Carn. Mus. Cat. No. 61.9260.

FIG. 2a. Section of gills of female (No. 45).

FIG. 2b. Section of gills of gravid female (No. 4).

FIG. 3. *Diplodon gratus* (Lea), from Rio Uruguay, Uruguayana, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5866.

FIG. 3a. Section of gills of male (No. 19).

FIG. 3b. Section of gills of female (No. 20).

FIG. 4. *Diplodon deceptus* (Simpson), from Rio Jacuhy, Cachoeira, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5868. Section of gills of half-grown female (No. 6) (Shell of this specimen figured on Plate XXXIX, fig. 4).

FIG. 5. *Castalina nehringi* Von Ihering, from Rio Tieté, Itapura, São Paulo, Brazil. Carn. Mus. Cat. No. 61.5120. Section of gills of gravid female (No. 5).

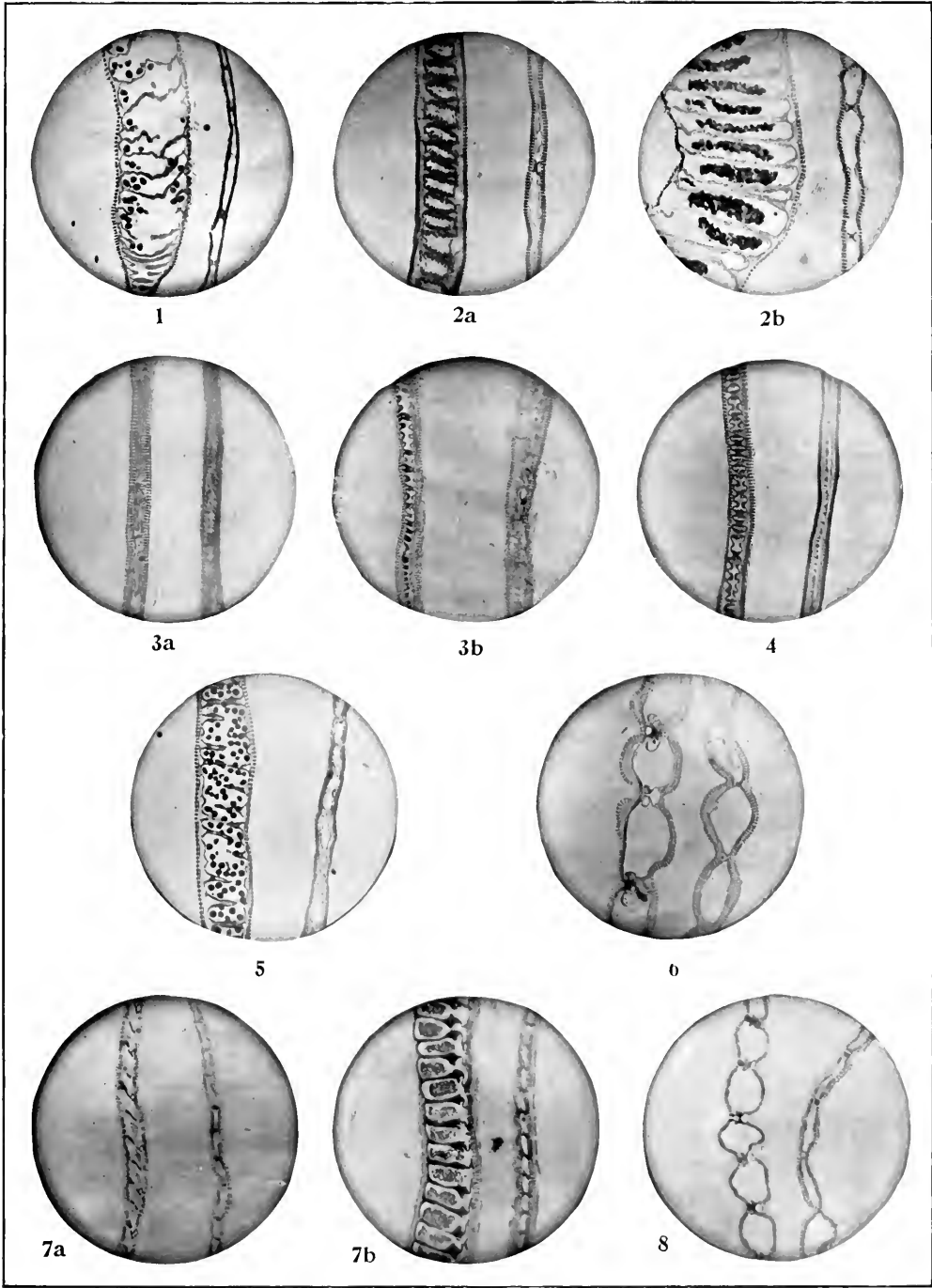
FIG. 6. *Fossula fossiculifera* (D'Orbigny), from Rio Tieté, Itapura, São Paulo, Brazil. Carn. Mus. Cat. No. 61.5840. Section of gills of female.

FIG. 7. *Monocondylaea minuana* D'Orbigny, from Rio Uruguay, Uruguayana, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5848.

FIG. 7a. Section of gills of male (No. 5).

FIG. 7b. Section of gills of gravid female (No. 6).

FIG. 8. *Anodontites patagonica rubicunda* (Lea), from Rio Cacequy, Cacequy, Rio Grande do Sul, Brazil. Carn. Mus. Cat. No. 61.5810. Section of gills of female.



ANATOMY OF DIPLONDON, CASTALINA, FOSSULA, MONOCONDYLEA, and ANODONTITES.



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